

Exploring Communication Techniques across a Wide Spectrum of Groups* – 15105

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ABSTRACT

Communication about radionuclide and nuclear waste is one factor in facilitating decisions regarding environmental issues and energy solutions. However, the decision process involves many people with a variety of perceptions that have been formed throughout many years. This paper describes various communication techniques across a spectrum of stakeholders from the general public, students, first responders, analysts, and decisions makers. Techniques include dose assessment tools, assessment training, preparing first responders to confront potential radiological/nuclear situations, web multimedia information, ongoing Department of Energy (DOE) education projects, public talks and presentations, and National Environmental Policy Act (NEPA) participation. Issues are identified concerning perception including units, background radiation, effects of environmental levels of radiation, potential approaches to energy literacy, and risk comparison. These various communication techniques across a spectrum of stakeholders are evaluated with feedback and use statistics concerning aspects of strategies, challenges, and common perceptions.

INTRODUCTION

Communication about radiation and nuclear waste is one factor in facilitating decisions regarding environmental issues and energy solutions. While the issues include clean-up costs, base load electricity, long-term waste storage or transmutation, nonproliferation, relative health risks, and radiological uses for both industry and medicine, much of the public associates the topic with nuclear weapons, nuclear power accidents, and popular culture shows. However, the decision process involves many people with a variety of perceptions that have been formed throughout many years. This paper describes various communication techniques across a spectrum of stakeholders from the general public, students, first responders, analysts, and decisions makers. Techniques include dose assessment tools, assessment training, preparing first responders to confront potential radiological/nuclear situations, web multimedia information, ongoing DOE education projects, public talks and presentations, and NEPA participation.

A problem with discussing nuclear waste is that often members of the public perceive nuclear waste issues as exotic, imposed, stochastic, expert dependent, and associated with weapons. Discussions about each of these perceived aspects may facilitate communication [1-4]. While nuclear waste is rather unusual for many, exposure to background levels of radiation is not. Radiation is used in many processes (although many are industrial) and in many medical procedures. The public involvement in large projects under the NEPA process may counter the perception of imposition. The stochastic aspect of radiation risk derives from both the risk of an accidental event and the long-term probabilistic aspects of the potential health hazards. In a technological society, these types of risks are common such as flying in a plane with the probabilistic risk of part failure, weather conditions, and exposure to germs and increased cosmic radiation. The concern of the dependence on experts has been mitigated through access to much information and tools on the internet. However, misleading information can also be found. Uncertainty regarding these issues is seen in conflicting data interpretations, such as in the debate concerning the effect of low-level environmental doses. Uncertainty could also be acknowledged in the potential for future technologies to either alleviate or exacerbate waste issues.

FIRST RESPONDER TRAINING

One of the outcomes from the response to the 9/11/2001 attacks was the increase in the preparation and prevention of WMD attacks including radiological and nuclear incidents. The Radiological Assistance Program of the Department of Energy [5] has played a major part in this by working with other agencies and training groups within the National Guard Civil Support Teams, firefighters, and law enforcement. While the use of radiological equipment is usually infrequent for these first responders, it is important to know basic facts so that real issues are addressed without too many false-positives. This includes awareness of commercial use of radioisotopes, examples of incidents, the workings of detectors, and the behavior of determining important characteristics of a potential issue.

The concepts of background levels, low level doses, and uncertain hazards are important for this understanding. The background levels are demonstrated with natural materials and building materials such as bricks and granite. The range of doses might be compared to a typical background dose of from 350-700 mrem per year. With the low end (1 mrem/day) as a standard, other major dose level criteria can be approximately derived by multiplying or dividing by 30. For example, the environmental regulations start at about 3% (1/30) of the background dose. Stochastic effects are seen at roughly 30 times the background level and lethality becomes a concern with another factor of 30 increase (i.e., about 1,000 times the background dose rate). This large logarithmic range is further complicated by the time units (per year, day, hour, minute); the use of prefixes such as milli, micro, nano, and the use of standard international (SI) units. One approach is to convey the scales in more relatable units, dose to units of money, for example, 1 rem = \$1. People seem to better understand the difference between a lethal dose of \$400 to an environmental limit of \$0.025 (two and a half cents). The natural background is about a quarter, and the complete background with medical is less than \$1. Effects are only seen above \$10.

Another technique is to develop a logarithmic dose thermometer, showing the range of doses from environmental to lethal, and showing the thermometer in a “bath” of radiation equivalent to the background which is over 10 times the environmental limit. On this scale various topics can be discussed including ranges of radiological protection for the public and workers; the level of doses in an incident such as action levels from Chernobyl or Fukushima; and the dose as a function of distance and time from a large sterilization source. Factors of 10 can be constructed to show how quickly a situation with these sources can turn from operational to hazardous.

Examples of commercial products are good to demonstrate the detector response to size, and identification. Such products include smoke detectors, granite samples, fertilizer, and fire bricks. Only one of these items, the smoke detector, uses the radiation for a specific purpose. The others are just incidentally slightly increased radiation levels.

Since the first responders only have short training with these detectors and materials with few opportunities to practice with real sources, an exploratory effort was made to use virtual reality (video gaming) technology to show how detectors might respond in real situations with changing background, different size detectors, and varying shielding.

PUBLIC INTEREST TALKS

The nuclear waste issue is not discussed frequently by the general public unless there are local activities or an accident occurs. Sometimes other topics that have a tangential nuclear waste component with a more positive aspect can be used to discuss the issues. For example, the Highly Enriched Uranium (HEU)

transparency program [6] was a 20-year agreement between the U.S. and Russia to convert the equivalent of 20,000 Russian nuclear warheads into low enriched uranium for U.S. reactor fuel by down blending. It ended in the Fall of 2013 when the last shipment was made from Saint Petersburg. While in operation this program was not widely publicized although a few web sites maintained information. Now that it is done, more publicity has been given to this program. There is some public interest in hearing more about the agreement and the U.S. participation in the Siberian monitoring.

At public talks on the project, the discussion often leads to other issues such as the difference between weapon, power plant, and natural grade uranium; the difference between how the U.S. and Russia are handling their excess enriched uranium; the difference between the disposition of the excess uranium and plutonium. These can lead to exploring nuclear weapons sites' waste issues and the long-term waste from nuclear power plants. The relative amounts of uranium needed for the reactors can lead to discussions of the availability of uranium resources along with the possible use of the more prevalent thorium resources or recycling the uranium isotopes in breeder reactors.

These issues are difficult to make popular, but there are some events that raise issues. Examples include Bill Gates' TED talk on the traveling wave reactor and the documentary Pandora's Promise. This can lead to discussions about the role of U.S. technology and research in nuclear power.

STAKEHOLDER AND DECISION-MAKER TOOLS

When a site that has radiological contamination in the soil needs to be cleaned, how clean is clean enough? RESRAD [7] is a software tool that was developed to address this question for cleanup of government and commercial sites, being sponsored by the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. It estimates a conservative level of radionuclides that might be left in the soil after cleanup so the hazards to present and future generation is relatively small.

To do this, simplifications of the mathematical models for radionuclide release, transport, and human exposure are made. Some of the parameters are site specific including the size of the contamination and the concentration of the radionuclides. An objective of the code is to bound the potential dose using equations, parameters, and methods that an informed user can follow and make sense of. To facilitate understanding, the user interface, documentation, results, analysis tools, and training are designed to clarify assumptions. Analysis tools include the use of graphical sensitivity analysis and uncertainty analysis.

Issues in the training include maintaining both the dose and health risk perspectives, providing information about the level of conservatism so that risks can be realistically compared with other types of risk, and developing international training (mostly through the IAEA) including units, language, and computer system differences.

EDUCATIONAL PROJECTS

The emphasis on Science Technology Engineering and Math (STEM) education has opened up some very interesting projects for student participation. Some of these deal with nuclear instrumentation such as the Department of Energy's Quarknet program [8] which is designed to get high school students involved with high energy physics experiments through measuring muons in cosmic rays. Again, while not directly a waste issue, many common topics come up such as background radiation, commercial applications of radioisotope sources, and the nature of radiation interacting with matter including living cells.

This successful program has been on-going for over a decade. The main requirements are the detectors, the electronics, the software, and an instructor. The four detectors are scintillator panels with a photomultiplier tube run in coincidence mode. Students volunteer for the after-school group that develops various experiments with the equipment. One relatively simple experiment is to determine the speed of light. This however requires the detectors to be calibrated and the ability to interpret the timing signals from the coincidence event. Other experiments include looking for muon showers (with the capability to coordinate with other schools in looking for very high energy showers), looking for correlations between timing of events, investigating scattering similar to what is proposed for scanning trucks for high Z materials.

The students propose experiments, review literature, and perform data analysis. The results are submitted for the regional and state science fairs where other students can see the results and discuss with the student participants. The students often do not intend to go into physics although many stay in science. The students and teachers participate during a summer boot camp and throughout the year in experimenting and hearing from field experts. The communication could be further developed with students giving local presentation to local classes and schools to make them aware of the opportunities and discuss the issues.

PUBLIC RESOURCES

Besides following the NEPA process for various waste projects, the supporting NEPA information is often organized on accessible websites. For example, the Depleted Uranium Management Information Network [9] has much of the information from the two Environmental Impact statements from the Depleted UF6 Conversion Facilities. Besides having the required legal documents it also has introduction to uranium, the possible uses, the NEPA process, and various risks. Videos detailing the DUF6 cylinders were digitized from a VHS tape. The original tapes were made with a professional actor under the direction of Bob Dyer of Oak Ridge National Laboratory in 1996. He was involved in creating the summary links and description of the digitized version. This digitization took place in January 2000, about 5 years before YouTube. Surprisingly, the video still work with only a few maintenance issues. Often environmental analyses will maintain a website with geographic information for those who want to do further analyses. The site also maintains the public comments and responses. A more recent website concerning an EIS is the Greater-Than-Class C Low-Level Radioactive Waste <http://www.gtceis.anl.gov/>

CONCLUSION

This paper explored approaches to have discussions concerning radiation and waste with a large range of groups including opinion leaders (students and first responders), decision makers, the general public, and concerned stakeholders through the NEPA process enhanced with website technology. New techniques were tried including new technology such as web-videos; simulation environments, use of more relatable units, and using tools that allow deeper understanding,

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