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Communications on nuclear, radiation, transport and waste safety: a practical handbook

INTERNATIONAL ATOMIC ENERGY AGENCY IAEA

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FOREWORD

Basic requirements to be met by national infrastructures for radiation protection and safety are stated in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (IAEA Safety Series No. 115). These include a requirement "to set up appropriate means of informing the public, its representatives and the information media about the health and safety aspects of activities involving exposure to radiation and about regulatory processes."

Communications on nuclear safety are needed for several reasons, such as: (a) to improve safety by providing information about nuclear technologies and educating people on how to avoid unnecessary exposure to radiation; (b) to learn from society about their concerns, and to address these concerns (c) to keep society informed about the safety standards that are set and how they are enforced; (d) to maintain social trust and confidence that nuclear technology is being operated at appropriate safety standards; and (e) to facilitate the decision making process on nuclear matters by presenting factual and balanced information.

This publication is intended for national regulatory authorities, to provide them with guidance on the principles and methods that can be applied in communicating nuclear safety to different audiences under different circumstances. This report presupposes the existence of an adequate national infrastructure, including an independent regulatory authority with sufficient powers and resources to meet its responsibilities.

The key questions addressed in this publication are: what communication should seek to achieve; what to communicate, to whom, when and how; and how to know whether communication is succeeding.

A major factor in addressing all of these questions is understanding the audience(s). A two-way communication process is needed to establish what particular audiences want to know and in what form they prefer to receive information. This will differ depending on the audience and circumstances. For example, the information on a routine day-to-day basis will be different from what might be needed at the time of an incident.

A range of audiences is discussed, including decision makers (government, politicians), the public (both in general and specific groups of the public, such as people living close to a regulated facility), the 'nuclear community' and influential non-governmental organizations (community groups, professional societies, pressure groups, etc.) with reference to their likely concerns, expertise and experience. Communication with the news media is a matter of particular importance, as they are both an audience in themselves and a mechanism for communicating with wider audiences. More detail is therefore provided concerning the pressures under which journalists work, and how information, and the provision of information, can be tailored to meet their needs.

The IAEA is grateful for the contribution made by experts from various Member States who took part in the development and review of this publication. P. Wieland of the Safety Co-ordination Section of the Department of Nuclear Safety was the IAEA's project officer for this work.

EDITORIAL NOTE

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1. INTRODUCTION

BACKGROUND

101. The applications of radiation and radioactive substances in medicine, industry, agriculture, and research along with the entire cycle of activities related to the generation of electricity in nuclear power plants, the management of radioactive wastes and the transport of radioactive materials are subject to numerous safety regulations, standards, recommendations and guides, from national and international sources. National regulatory authorities exist to develop, interpret and enforce these, in order to assure the safety of these activities and protection against the risks of ionizing radiation.

102. However, the general public are largely unaware of the existing mechanisms to assure the safety of radiation sources, the scale to classify the incidents and accidents or the national and international arrangements to respond to severe accidents that could involve releases of large quantities of radioactive substances to the environment, with the possibility of acute health effects. Public opinion research shows that people would like to know more about nuclear topics and are concerned about safety issues and the capacity of the country to control radiation sources and respond to accidents.

103. The International Basic Safety Standards for Protection against Ionizing Radiation and the Safety of Radiation Sources [1] define requirements that need to be met within a national infrastructure for radiation protection and safety. One such requirement is "to set up appropriate means of informing the public, its representatives and the information media about the health and safety aspects of activities involving exposure to radiation and about regulatory processes".

104. It is therefore felt that the regulatory authorities throughout the world should make an effort to have a proactive attitude towards society by publicizing all the work that has been carried out in the fields of nuclear and radiation safety to ensure a responsible utilization of nuclear energy worldwide.

105. However, this would have to be done within the other conditions placed upon the regulatory authority, notably that it "should be independent of any Government departments and agencies that are responsible for the promotion and development of the practices being regulated." Therefore, the regulatory authority's task is to provide information about safety, and the regulatory measures used to ensure it, without being 'promotional' with respect to the regulated activities.

106. It is recognized that this is a challenging task. 'The public' is not a single homogeneous group, and therefore the communication must be aimed at a range of more specific audiences, such as decision makers, the media, the 'nuclear community' and non-governmental organizations, as well as the general public. These different audiences will have a range of different concerns, levels of knowledge and experience of 'nuclear' issues, and will therefore call for communication at different levels of technical detail, via different channels.

107. It is also of paramount importance that the regulatory authority should foster the dissemination of a safety culture through the encouragement of a long term educational programme in the established school system on the basic concepts of radiation and nuclear safety.

OBJECTIVE

108. This publication is mainly intended to assist those regulatory authorities which need to establish or improve their national programme on communicating nuclear, radiation, transport and waste safety to different audiences, such as to decision makers, the media, the public, the nuclear community and non-governmental organizations.

SCOPE

109. The scope of this publication is intended to include all forms of communication undertaken by the regulatory authority concerning nuclear safety. This does not include the communication that is essential in the course of the other aspects of the regulatory authority's role, such as those with licensees about inspection, or with legal personnel about enforcement. It would, however, include (for example) more general communication with anybody (including licensees and their employees or legal personnel) about the objectives and functions of regulators, or about safety issues in general.

110. The scope of this publication includes both proactive and reactive communication. Hence it includes both planned, routine communication programmes and communicating in response to events, whether in the form of real incidents or 'media-generated events', i.e. those reports that reach the public at large without any real foundation and yet might arouse anxiety.

111. The scope of subjects for such communication includes the safety of nuclear installations, radiation protection and the safety of radiation sources, the safe transport of radioactive materials, planning, preparedness and response to emergencies and the safe management of radioactive waste. For the sake of simplicity, however, the term 'nuclear safety' has been used in this publication to describe the subject matter to be communicated. Unless otherwise stated, this term can be assumed to include nuclear, radiation, transport and waste safety.

STRUCTURE

112. The handbook explains the functions of the regulatory authority in communicating with the public about safety matters. It then explains the basic topics that are of main interest in communication such as key elements for safety, control of radiation sources, applications of ionizing radiation, production of nuclear energy, fuel cycle activities, transport of radioactive material, waste management, emergency planning preparedness and response. The planning, implementation and evaluation of the communication programme follow, which include a description of the different kinds of audience and provide advice on how information about each element can be transmitted in a communication programme and best be understood by the target audience. The annexes contain examples of home page addresses in the Internet for further consultation; examples of written communications in the form of press releases and examples of communication programmes in an emergency situation and on a routine basis.

2. ROLE OF THE REGULATORY AUTHORITY

201. The regulatory authority has a very important role in the communication of nuclear safety to the population. It is the regulatory authority which establishes, controls, inspects and enforces the nuclear regulations. It is often the first to be contacted when there is an abnormal situation. The regulatory authority, as a body with independent functions to control the use of radiation, is the appropriate organization for providing independent, neutral, balanced and factual information about any issue related to nuclear safety in the country. This position gives the necessary credibility to the regulatory authority. Nonetheless, a communication programme must be in place to create and maintain this image.

202. The roles and responsibilities of regulators and licensees are different and so are their messages. It is fundamental to transmit the message that the regulatory authority is responsible for the national control of the use of radiation sources and not biased in favour of promotion of the nuclear industry.

203. There are many difficulties in conveying messages on nuclear safety to the public. Much of the difficulty relates to the technical language that experts use routinely in their work, and therefore tend to use when communicating with others.

204. There are also more mundane problems with establishing a good communication programme, such as:

(a) the other duties of the regulatory authority in developing regulations; inspecting and enforcing are commonly perceived to be more important and urgent. This can result in only reactive communication taking place, i.e. only when there is an incident;
(b) the lack of dedicated personnel with a good level of technical expertise and a talent for communication; and
(c) the absence of an adequate budget for a communication programme.

205. The communication challenge for regulatory authorities is therefore to provide independent, factual information to explain how they are ensuring the safety of activities involving radiation and radioactive materials. In order to develop trust and understanding between the regulatory authority and its audiences, communication obviously needs to be open and honest, but the development of such a relationship also depends on regular and consistent communication.

206. Clearly, the regulatory authorities have a particular need to communicate when incidents occur or when issues are raised, but the communication in these 'crisis' situations is likely to be much more effective if a relationship has already been established through regular routine communications. Hence proactive communication about safety and regulation when there are no incidents to report can be just as important as communication in response to events.

207. The channels of communication between regulators and licensees should be always clearly identified and the communication should be constant, formal and official. Aside from the routine interactions, two special types of communication which are also indicative of a good relationship between those two parties are:

(a) notification of unusual events — regulators should be kept informed by the licensees of any unusual event related to safety conditions in an installation, even if this event is unlikely to progress to an emergency situation. Permanent communication in crisis situation avoids any contradiction or inconsistencies in communication to third parties.
(b) feedback on recent safety developments and inspections completed — regulators should inform the licensees about new guidance on safety matters, give feedback about inspection reports on the installations or on radiological assessment due to an unusual event or accident.

208. The communication of nuclear safety with decision makers, such as high level governmental representatives and Parliamentarians, facilitates political decisions such as those related to the approval of adequate budget and organizational infrastructure for nuclear safety, improves relationships and co-ordination of joint activities and strengthens the regulatory authority as a whole.

209. If the regulatory responsibilities for nuclear safety are divided between a number of different organizations, effective arrangements need to be made to ensure that communication activities are co-ordinated to provide coherent information, or at least to avoid seemingly contradictory information being disseminated by the different organizations.

210. One other perhaps less obvious type of communication responsibility is communicating with regulatory counterparts in other countries. Such exchanges of information and experience may be of assistance in carrying out not only the communications role of a regulatory authority, but also in discharging its other responsibilities. International communication between regulators can range from informal bilateral or regional exchanges to the much more formal process of exchanging information under the terms of inter-governmental treaties such as the Convention on Nuclear Safety or the Convention on Early Notification of a Nuclear Accident.

211. Regulatory authorities are encouraged to consult more broadly and to work with technical universities, NGOs, professional organizations, etc., in order to exchange information, increase awareness of regulatory authority work and get acquainted with new scientific and technical developments, to understand and address the concerns of the scientific community.

212. This publication does not refer to the issue of regulations by the regulatory authority. However it is recognized that nowadays more and more lay persons read and analyze the regulations for several reasons: e.g. as a user, an NGO, or simply as a critical observer. Therefore, the preparation of regulations should take into account this fact to avoid any misinterpretation of the content due to a lack of careful explanation of any technical term or procedure.

3. KEY MESSAGES TO BE COMMUNICATED

301. The overall objective of this section is to provide the basic safety elements and messages that may be used by the regulatory authorities in their communication programmes. The structure of this section allows quick reference to specific elements that may be of concern to a variety of audiences. The language used is intended to be very clear, to be readily transmitted to the non-nuclear community. The messages to be communicated should always provide the facts about nuclear issues in a neutral and balanced manner and always emphasize the existence of a regulatory authority and its responsibilities to control the use of radiation sources in the country.

302. People need clear, simple, straightforward, and easy to understand explanations, which give them an overall impression or an image. They do not want to become experts, they simply want to know if something is safe and what the regulatory authority is doing in concrete terms to protect public health and safety. For example, the public often asks about safety. Technical experts often respond using relative risk comparisons. These comparisons make many people afraid of the other topic with which they are comparing, and because comparisons are relative, members of the public and other non-technical audiences have no way to judge what is being said. Therefore, people think the expert is trying to hide something or is not being direct. People often need to be reminded of the most simple aspects about nuclear technology, because usually they know very little, if anything at all.

303. The regulatory authority should communicate its activities in order to address the safety of the sources of radiation and to protect humans and the environment. The advantages and disadvantages of the production of nuclear energy and of the applications of ionizing radiation and the associated risks are important topics for discussion while deciding on the authorization of a new installation. However, the promotion of nuclear energy should be left to the interested operators and to the respective industry. The regulatory authority should remain independent to meet its responsibilities to ensure the control of any activity related to sources of radiation.

304. The basic safety elements of the nuclear area are presented below followed by the general issues related to the regulatory control of radiation sources and by some practical examples for communicating nuclear safety in different activities related to the nuclear area. Frequent issues raised by the public (major public concerns) are presented and key safety messages to be communicated to the public are suggested. Those messages are written in a clear language and may have to be modified to cope with different national needs. This section deals with the most common messages to be communicated, however, according to different national applications of sources of radiation it may be necessary to identify the specific public concerns in a country. Section 4 deals with methods on how to do this.

305. For further information, the IAEA offers a wide variety of technical publications. Updated information on current international issues can be found in the IAEA home page at http://www.iaea.or.at/worldatom/. As an additional resource on nuclear applications, the Division of Public Information provides booklets and general information materials. Annex A shows a list of Internet home page addresses on communication with the public covering radiation related issues. Those resources may have to be modified in shaping the messages for the regulatory authority's point of view.

306. There are some characteristics of nuclear technologies that are important to be communicated as they reflect the safety fundaments and the basis of development of nuclear applications. The following list explains these elements:

Safety culture

307. The implementation of the safety culture [2] is a key consideration in ensuring the safe use of sources of radiation.

308. Safety culture has two general components. The first is the necessary framework within an organization and the responsibility of the management hierarchy. The second is the attitude of staff at all levels in responding to and benefiting from the framework.

309. In all types of activities, for organizations and for individuals at all levels, attention to safety involves the attitudes listed below. These attitudes of safety culture, together with the following elements, are strongly related to a global nuclear safety culture infrastructure.

(a) *Individual awareness* of the importance of safety.

(b) *Knowledge and competence,* conferred by training, qualification and instruction of personnel.

(c) *Commitment,* requiring demonstration at all levels, including at senior management level of the high priority of safety and adoption by individuals of the common goal of safety.

(d) *Motivation,* through leadership, the setting of objectives and systems of rewards and sanctions, and through individuals' self-generated attitudes.

(e) *Supervision,* including audits and review practices, with a readiness to respond to individuals' questioning attitudes.

(f) *Responsibility,* through formal assignment and description of duties and their understanding by individuals, as well as clear lines of authority for decisions.

Learning from experience

310. Extensive research and study over a long period of time have gone into learning about and understanding radiation. This contributes to the development of safe nuclear technologies. Based on experience gained and on new developments, nuclear technologies continue to be improved.

Nuclear technologies designed and tested to prevent accidents

311. Because scientists and engineers know that accidents can happen, they design nuclear technologies to make accidents as unlikely and rare as possible. The design is based on the complexity and potential danger of the particular technology. Design-based accident prevention concepts include: multiple barriers, redundant safety systems, diversity of safety systems, the fail-safe principle, and physical separation.

International co-operation

312. Information about nuclear technologies is shared worldwide to ensure that all nations have access to the best information available. Most nuclear professionals communicate regularly via the Internet and telephone, and meet periodically to discuss and present new information. International nuclear associations organize conferences and periodic meetings to facilitate exchange of information and international collaboration.

Safety conventions

313. Interdependence in the nuclear field calls for legally binding instruments. The International Atomic Energy Agency (IAEA) facilitates the establishment of international conventions on nuclear safety such as:

(a) Convention on the Early Notification of a Nuclear Accident (1986);

(b) Convention on the Assistance in the Case of a Nuclear Accident or Radiological Emergency (1987);

(c) Convention on the Physical Protection of Nuclear Material (1987);

(d) Convention on Nuclear Safety (1996);

(e) Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997) ; and

(f) Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage and the Convention on Supplementary Funding (1997).

International safety standards

314. Safety and protection issues have been taken into consideration on an international level. The IAEA affirmed the importance of safety in its statute more than 40 years ago and has been working ever since towards international harmonization of safety and radiation protection principles. All nuclear technologies are recommended to meet minimum standards of nuclear safety set at the international level by the IAEA and by the International Commission on Radiological Protection (ICRP).

National regulatory authorities

315. All nuclear technologies are regulated to ensure that they meet standards that protect public health and safety. The highest priority has been given to safety and protection when establishing national regulations and procedures Safety and protection issues were identified and dealt with according to their significance. National regulations are usually based on international recommendations and guidelines are often even stricter than the international rules. The regulatory function is effectively independent of the promotion or utilization of nuclear energy functions and it has adequate authority, competence and resources to fulfil its assigned responsibilities. It has responsibilities for issuing authorization to use radiation sources, assessing safety conditions and performing inspections. Measures or sanctions may be applied in case of non-compliance with established safety criteria.

Independent expert review and consultation

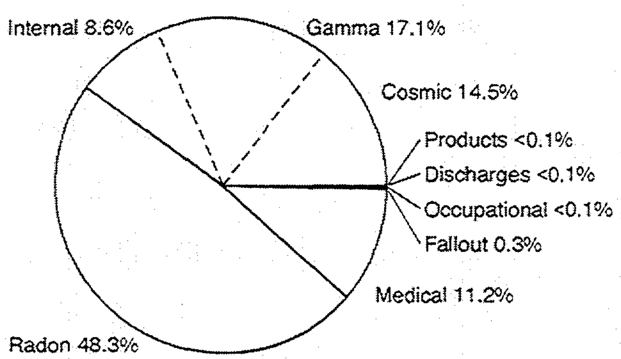
316. In many cases independent experts with recognized high-level credentials review policy, procedures, operations and new developments to ensure overall safety. Quality, consistency and scientific accuracy are based on best available knowledge.

Public processes

317. Public processes, such as informal consultations or formal public hearings, provide opportunities for the public to participate in the discussion about a proposed project which could have some potential for a direct economic or environmental impact on them. During such processes, members of the public have direct access to the authorities as well as the implementing organization to ask questions as well as to make their concerns known about the project. Through these processes, the public can have an influence on the project's outcome.

CONTROL OF SOURCES OF IONIZING RADIATION

318. We are all exposed every day to ionizing radiation from various sources. Some sources of radiation are natural and some are man-made. Nature is the largest source of exposure, as can be seen in Figure 1.



The average yearly global radiation dose from all sources of radiation is 2.7 millisieverts, made up of the components shown in the diagram.
(Source UNSCEAR)

FIG.1. Sources of exposure to ionizing radiation [3].

Natural sources of radiation

319. *Cosmic radiation* comes through the earth's atmosphere, some from the sun and energy sources in our galaxy or outside it. The global yearly average dose is **0.39 mSv**.

320. *The Earth's crust* is also made up of materials that are naturally radioactive. Uranium, for instance, is dispersed throughout rocks and soil, mostly at very low concentrations. So are thorium, carbon-14 and potassium-40. Since building materials are extracted from the earth, they can be slightly radioactive, and people are irradiated indoors as

well as out of doors. The radiation doses vary according to the rocks and soils of the area and the building materials in use but the global yearly average is **0.46 mSv.**

321. *Radon* is a naturally radioactive gas that comes from the uranium that is widespread in the earth's crust. It is emitted from rocks or soil at the earth's surface and disperses in the atmosphere unless it enters a building, in which the concentration can build up. Radon decays to form other radioactive atoms which, when inhaled, can lodge in the lung and irradiate tissue. The global yearly average dose is **1.3 mSv** but in high radon areas the doses can be many times higher. The radiation dose can most easily be reduced by preventing the radon gas from entering it in the first place.

322. *Food and drink.* Since radioactive materials occur everywhere in nature it is inevitable that they get into drinking water and food, giving a global yearly average dose of **0.23 mSv.** Potassium-40 in particular is a major source of internal irradiation, but there are others. Potassium-40 in the body varies with the amount of muscle, for instance, being twice as high in younger men than in older women. Some foods, for example shellfish and Brazil nuts, concentrate radioactive materials so that people who consume large quantities can receive a radiation dose significantly above average.

323. *Non-nuclear industries* can technologically enhance naturally occurring radioactive material. They include the processing of ores containing radioactive materials as well as the element for which the ore is processed. Phosphorus ores, for instance, contain radium, which can find its way into the effluent. The term NORM (Naturally Occurring Radioactive Material) as used by regulators and waste managers, generally refers to those radioactive materials that have been concentrated unintentionally to worrisome levels by unregulated activities, such as, for instance radium in the oil and gas industry. A non-nuclear related industry, the generation of electricity by coal-fired power stations, results in the release of naturally occurring radioactive materials from coal. These are discharged to air and transferred through food chains to the population. However, the radiation doses are low — **0.001 mSv or less.**

Man-made sources of radiation

324. *Medical.* Radiation is used in medicine in two distinct ways: to diagnose disease or injury; and to kill cancerous cells. In the oldest and most common diagnostic use, X rays are passed through the patient to produce an image. For some diseases, diagnostic information can be obtained using gamma rays emitted by radioactive materials introduced into the patient by injection, or by swallowing or by inhalation. This technique is called nuclear medicine. The radioactive material is chosen so that it preferentially locates in the organ or part of the body being studied. To follow the distribution or flow of the radioactive material a "gamma camera" is used. It detects the gamma radiation and produces an image, and this indicates whether the tissue is healthy or provides information on the nature and extent of the disease.

325. Cancerous conditions may be treated through radiotherapy, in which beams of high energy Xrays or gamma rays from cobalt-60 or similar sources are used. They are carefully aimed to kill the diseased tissue, often from several different directions to reduce the dose to surrounding healthy tissue. Radioactive substances, either as small amounts of solid material temporarily inserted into tissues or as radioactive solutions, can also be used in treating diseases, delivering high but localised radiation doses.

326. Medical uses of radiation are by far the largest source of man-made exposure of the public; the global yearly average dose is **0.3 mSv.**

327. *Atomic bomb testing.* Radioactive materials are also present in the atmosphere as a result of atomic bomb testing. They may lead to human exposure by several pathways: external irradiation from radioactive materials deposited on the ground; inhalation of airbome radioactivity and ingestion of radioactive materials in food and water. However, access to the areas affected by the consequences of the tests is not allowed to the public.

328. *Nuclear industries, as well as hospitals* and research centres discharge radioactive materials into the environment. Nearly all countries regulate industrial discharges and require the more significant to be authorized and monitored. Monitoring of such effluent may be carried out by the government department that authorizes the discharges up to the acceptable limit as well as by the operator.

329. *Nuclear energy generating plants and other fuel cycle facilities* release small quantities of a wide variety of radioactive materials at each stage in the nuclear fuel cycle. For the public the global yearly average dose is **0.008 mSv.**

330. *Accidental releases of radioactive materials.* Apart from radiation due to the normal operations of the nuclear industry, radioactivity has been dispersed accidentally. The most significant accident was at the Chernobyl nuclear power station in the Ukraine, where an explosion caused the release of large amounts of radioactivity over a period of several days.

331. *Radiation in consumer products.* Minute radiation doses are received from the artificial radioactivity in consumer goods such as smoke detectors, lightning devices and luminous watches, and from the natural radioactivity of gas mantles. The global yearly average dose is extremely small **(0.0005 mSv).**

Biological effects of ionizing radiation

332. The health effects of radiation may be divided into those that occur early after exposure and those that may occur years later.

333. It has long been recognized that exposure to levels of radiation greater than 100 mSv can harm the human body. Such radiation effects can be clinically diagnosed in the exposed individual because once a radiation dose above the relevant threshold has been received, they will occur and the severity depends on the dose.

334. Exposure to radiation can also lead to the development of cancer several years later and, possibly, of hereditary effects. Effects such as these cannot usually be confirmed in any particular exposed individual, but can be inferred from statistical studies of large populations. They appear to occur at random in the irradiated population. The recommended limits of dose where established to prevent such effects. Information on biological effects of ionizing radiation is assembled and published periodically by a number of experts bodies such as UNSCEAR.

International standards for radiation protection

335. To control the radiation exposure of workers, medical patients and the public, many countries have developed laws, which are supported by administrative measures and enforced by inspectors. Equally important is to have internationally agreed standards, and the IAEA has played a lead role in developing and refining these. In 1996 the IAEA, together with the World Health Organization, International Labour Organization, OECD Nuclear Energy Agency, Food and Agriculture Organization of the United Nations and Pan American Health Organization updated and issued its International Basic Safety Standards for Protection against Ionizing Radiation and the Safety of Radiation Sources (BSS) [1].

336. The Standards are intended to set recommendation to ensure the safety of all types of radiation sources, including nuclear reactors and radioactive waste. The Standards are not mandatory, but serve as reference to all those involved in radiation protection and safety, taking into account local situations, resources, etc. The BSS are enforced in all activities involving IAEA assistance and support. Additional publications issued or to be issued by the IAEA on the subject includes recommendations, practical examples and detailed methods, on the basis of international experience, relating to the fulfilment of basic requirements [4].

Principles of radiation protection

337. There are activities that add radiation exposure to what people normally receive due to background radiation, or that increase the likelihood of incurring exposure. These are called *practices* and include the use of radiation or radioactive substances for medical, industrial, agricultural, educational, training and research purposes and, of course, the generation of energy by nuclear reactors. Also included are facilities containing radioactive substances or devices such as irradiation installations, mines and mills processing radioactive ores and radioactive waste management facilities.

338. There are other activities that seek to reduce the existing radiation exposure, or the likelihood of incurring exposure. These are called *intervention* and apply to chronic exposure situations such as radon in buildings, and emergency situations for the cleanup of areas contaminated in the aftermath of an accident.

339. Protection under the BSS is based on the principles of the International Commission on Radiological Protection: *Justification of the practice and intervention*; *limitation of individual risk;* and *optimization of protection.*

340. In addition, a system of organizational, managerial and technical requirements should be in place.

341. *Organizational requirements:* National governments have the responsibilities for enforcing radiation safety standards, through a system that includes a legal framework and a regulatory authority with responsibilities of implementing a system of notification, registration, licensing and control of radiation sources. In addition, governments provide a national infrastructure that includes training and information requirements and essential services.

342. *Management requirements:* To ensure radiation safety, the BSS promote the development of a safety culture, quality assurance programmes, control of human factors,

limiting, as far as practicable, the contribution of human error to accidents, and availability of qualified experts.

343. *Technical requirements:* The BSS promote sound technical planning and implementation through security of sources, defence in depth, good engineering practice and verification of safety.

CONTROL OF SOURCES OF IONIZING RADIATION

Major public concerns

- **What does a radiation source look like? What should I do if I find a radiation source?**
- **Is any level of radiation dangerous? Is it safe to work with radiation?**
- **Why is there no agreement among scientists on the risks of low level radiation?**
- **What are the possible effects of radiation on human beings?**
- **What are the possible effects of radiation on the environment?**
- **Can a human become sterile or impotent due to radiation exposure?**
- **I have heard about the benefit of radiation to human beings, is this the truth?**
- **Why do international organizations, like IAEA, from time to time, approve new recommendations to reduce dose limits to protect workers and the public?**
- **What is the cost of safety?**
- **Is radon really so dangerous?**

Key messages to be communicated

- The types of sources of radiation, the interaction of radiation with matter.
- Most of the ionizing radiation that people are exposed to comes from natural, rather than man-made, sources.
- The trefoil sign indicating the presence of radiation.
- Biological effects of irradiation, making a clear distinction between whole body exposure and partial body radiation and high/low dose exposure.
- Difference between external exposure and external/internal contamination.
- The quantity 'dose', the unit sievert and its sub-multiples, comparing the dose received from various types of exposure (e.g. radon, intercontinental flights, medical applications, accidental doses, etc.).
- Principles of radiation protection and how the limits of dose were defined.
- Safety measures and practices to effectively minimize exposure to radiation.
- The IAEA, together with other international and expert organizations, is helping to promote and institute Basic Safety Standards on an international basis to ensure that radiation sources are managed for both maximum safety and human benefit.
- Radon mitigation procedures.
- Activities of the regulatory authority to control the use of radiation sources.
- Contact point in the regulatory authority for more information about radiation issues.

Nuclear energy plants

344. The decision to construct a nuclear energy plant is based on the energy needs of the country, the existing policy and the comparison with other sources of energy. It involves extensive planning and preparation. Considerations include an environmental impact statement (EIS), plant design, construction, commissioning, operation and maintenance [5, 6].

345. The safety requirements for nuclear energy plants account for a large part of plant station hardware operation, training, operating strategy and cost. Precisely how the safety requirements are fulfilled differs for the different types of reactors, but the fundamental safety principles are the same for all plants.

346. During its licensing procedure, each nuclear installation has to prove that no allowable limit of radioactive release will be exceeded, not only during normal operation, but also under fault or accident conditions. The priority is to prevent failures rather than simply to mitigate their consequences, but the design also takes into account the possibility of failures that may happen, despite all precautions.

347. There are many basic built-in *safety features* and *design safety principles* common to all reactor systems. The most important of these are redundancy, diversity, physical separation, and the multiple barrier concept. At all times there must be a correctly working system to fulfil each protection and safety function.

348. The basic aim in safety of nuclear energy plant is to maintain the integrity of the multiple barriers. This is assured through the defence-in-depth approach, which can be characterized by preventive measures, protective measures and mitigation measures.

349. For research reactors, any safety considerations are very similar and could also be among the concerns of the public.

Uranium mining and milling

350. Uranium is very widely distributed in the earth's crust and oceans, and is found in large economic reserves throughout many regions of the world. Uranium is extracted by a number of means: conventional open-pit mining, underground mining and solution mining (in-situ leaching) and as a by-product of some phosphate mines. The uranium is extracted from the crushed ore in processing plants or mills using chemical methods appropriate to the specific mineral form. The uranium concentrate produced in the ore, commonly known as yellowcake, is, depending on its quality, further purified in a refinery before being shipped in metal containers to a conversion plant.

351. The main issues associated with uranium mining and milling operations are the radiation and chemical toxicity from the various elements, especially the uranium, thorium, radium and radon. Other trace elements such as arsenic, lead, copper or zinc may be found in different concentrations depending on the geological characteristics. Radium and radon are not unique to uranium/thorium mining but also occur in many other mining operations, for instance aluminium, semi-precious gems and gold mining and milling. Procedures are in place at the mines or mills to minimize the hazards due to the toxicity of the radioactive components

NUCLEAR ENERGY PLANTS

Major public concerns

- **Are nuclear reactors perfectly safe?**
- **What has been done to prevent accidents?**
- **Are there releases of radioactive material during normal operation? Can they change the local climate? What are the environmental consequences?**
- **Can you produce nuclear weapons in a nuclear energy plant?**
- **Can a nuclear plant blow up like a bomb?**
- **Is some kind of sabotage possible?**
- **What about diversion of material to countries wanting to make bombs?**
- **Is the use of a nuclear plant reactor absolutely essential to the maintenance of progress?**
- **How is the efficiency compared to other sources of energy?**
- **Is a nuclear reactor economically viable? How long will the construction last?**
- **How many operating nuclear plants are there in the world?**
- **How much waste does a nuclear plant produce per year and how is it dealt with?**
- **Can population live in peace near a nuclear reactor?**
- **Are there any benefits to living near a nuclear reactor?**

Key messages to be communicated

- The licensing process of the nuclear energy plant, including a complex process of procedures, EIS, safety assessments and public hearings.
- The plant is inspected regularly to monitor its safety conditions and verification of diversity of nuclear materials.
- Appropriate quality assurance programmes approved by the regulatory authority, applied to siting, design, operation, maintenance and decommissioning are implemented.
- All releases of radioactive material to air and to water are minimized by appropriate filter systems. They are monitored regularly to check compliance with established limits.
- The temperature of the water and steam released to the environment is controlled.
- Nuclear accident (see Section on emergency).
- Number of plants of that type operating around the world and its safety performance.
- Radioactive waste (see Sections on transport and radioactive waste).
- Physical protection systems are in place to prevent terrorist and criminal acts.
- It is not possible to build a bomb with radioactive material from a nuclear energy plant without complex and highly sophisticated further treatment of the material; the plant itself cannot blow up like a bomb (it is important to explain why).
- Explain the concept of advanced safety design nuclear reactor.

as well as the toxicity of other chemical components common to wastes from other mining and milling operations.

352. The wastes include large volumes of solids, or tailings, and liquids as well as small quantities of airborne contaminants. These must be managed during the operations to ensure that there is no adverse impact on people or the environment. As most of the radioactivity present in the ore is discharged with the tailings, there is a continuing need to manage the wastes after uranium mining and milling operations are completed.

353. In some countries the regulatory authority requires an Environmental Impact Statement (EIS) that provides a detailed description of the proposed project and the anticipated environmental and socio-economic impacts associated with its implementation. The EIS is prepared before the development of the uranium mine and mill operation. An effective EIS may address likely public concerns during required public hearings. These issues may be in connection with the establishment, operation and closure of the facilities.

URANIUM MINING AND MILLING

Major public concerns

- **What impact the operation is causing on the quality of the groundwater in the area?**
- **Are the safety standards set by the authorities for workers and the public being met?**
- **How will the uranium/yellowcake be dispatched from the uranium mine/mill and will it be transported through residential areas?**
- **What is being done to control the radiation levels?**
- **Does the operation match the requirements as set out in the EIS?**
- **Once the operations have been completed, will the area be restored for public use?**
- **Who will be responsible for the site and maintain it after the company has left?**
- **Who will pay for the cleanup? How long will the rehabilitation take?**
- **How will the tailings facility(ies) be made safe?**
- **What are the worldwide reserves of uranium for the long term production of electricity from nuclear energy?**

Key messages to be communicated

- Description of uranium — its colour, form and packaging.
- The operations at a uranium mining facility are, similar to the conventional mining operations. Some special precautions need to be taken to handle the uranium and tailings which is called waste. These precautions need to meet the requirements of the regulatory authority to ensure the health and safety of workers and the public as well as the protection of the environment, including groundwater, surrounding lakes and fish stocks.
- A license, based on the EIS, is required from the regulatory authority to establish and operate the uranium mine and mill operations. Standards are set in the license to ensure safety and the uranium operator must adhere to the standards in order to continue operating. There will be a penalty if the operator does not meet the standards.
- After closure of the uranium mining and milling operation, there will continue to be controls by the operator and the regulatory authority over future uses of the site for the long-term.
- The tailings are stabilized and covers are placed over the tailings to minimize the entry of water and escape of radon. Monitoring is required to ensure that the structure of the tailings and dams continue to function as licensed for as long as is required.

Nuclear fuel cycle activities [7]

(a) Fuel fabrication including conversion and enrichment

354. Uranium ore is used to make nuclear fuel for nuclear energy plants. For reactors requiring enriched uranium fuel, the uranium ore must first be converted from a solid to a gaseous state to be enriched. This is done by fluorinating it with fluoridric acid (HF). Once the material is in a gaseous state it is called uranium hexafluoride (UF_6). This gas is then transported to a company or government organization which performs a process called enrichment. Uranium must be enriched because in its natural state it contains less than 0.1% of ^{235}U atoms and this is not enough for an efficient fission to take place to create a chain reaction. Most uranium used in nuclear fuel is enriched so that it has between 2 and 5% ^{235}U atoms. The CANDU (Canadian Deuterium Uranium) reactors use natural uranium, therefore no enrichment is needed. Gaseous diffusion and the centrifuge process are the two principle processes for uranium enrichment.

355. The enriched uranium hexafluoride is chemically converted to pure uranium dioxide powder, which is pressed into pellets and further processed. These pellets are sealed in alloy or stainless steel tubes, depending on the reactor type, and are called fuel rods. The fuel rods are put together in a fixed geometry called a fuel assembly. Fuel assemblies are placed inside the reactor along with control rods.

NUCLEAR FUEL FABRICATION

Major public concerns

Most of the concerns related to nuclear reactors are the same for fuel fabrication plants.

- **Is there any release of radioactive material to the environment during the fuel cycle?**
- **Are there any chemically and toxicologically relevant materials released, which may lead to health impacts and environmental contamination (air, water, and food production)?**
- **Is it true that plutonium is used in the production of MOX fuel?**
- **Can nuclear material be diverted from these plants to produce bombs?**
- **Can the facility explode?**

Key messages to be communicated

Similar to relevant items from Nuclear Energy Plant. Additionally, subpressure cells and systems of ventilation with filters are in place to protect against hazardous gases.

(b) Reprocessing facilities

356. The spent nuclear fuel contains about 1% of unburned uranium-235, more than 90% of the uranium-238 originally present in the fresh fuel, and between 0.5 and 1% of plutonium, as well as actinides and fission products such as caesium-137 and iodine-131. The mechanical and chemical processes to separate uranium and plutonium are called reprocessing.

FUEL REPROCESSING
Major public concerns
• **Public concerns are similar to other nuclear fuel cycle facilities (see above).** • **Is it possible for criticality accidents to occur, as well as releases to environment of radioactive and chemically highly toxic materials (i.e. plutonium) which may lead to health impacts?** • **What is the long-term environmental contamination (air, water, and food production)?** • **Is it necessary to reprocess spent fuel or not?** • **What about the waste?** • **What is really the situation in the environment around the La Hague and Sellafield facilities?**
Key messages to be communicated
Similar to other fuel cycle facilities plus explanation about waste management and transport. Transmit updated and factual information of the situation of operational reprocessing plants.

(c) Interim storage of spent fuel and spent fuel disposal

357. Spent fuel is highly radioactive and gives out considerable quantities of heat. It is therefore placed in water pools where it can be cooled for several years. After the period of cooling in pools at the reactor site the still highly radioactive fuel elements are conditioned and may be loaded onto shielded transport containers that meet the most stringent international recommendations and shipped to an interim storage facility. The interim storage facility is usually at the reactor site or at the reprocessing site.

358. Following interim storage for a number of years, spent fuel or solidified blocks containing the high level waste can be transported to a final repository. There they remain under supervision and, when appropriate, are sealed off permanently.

INTERIM STORAGE OF SPENT FUEL AND SPENT FUEL DISPOSAL
Major public concerns
(see also Management of Radioactive Waste) • **How dangerous is the spent fuel and for how long?** • **How much spent fuel has been produced so far?** • **What happens when the water cooling fails?** • **Is it possible that after a long period of time radioactive material from disposed high level waste is released to the environment?** • **What happens with the storage facility if there is an earthquake?** • **Will future generations suffer health effects from our radioactive wastes?**
Key messages to be communicated
• *See Management of Radioactive Waste*

Applications of ionizing radiation in medicine, industry, agriculture and research

359. The use of radiation sources of various types and activities is becoming increasingly widespread in industry, medicine, agriculture and research in virtually all countries and has generally been accompanied by a good safety record. However, in some countries the control of radiation sources is not adequate. Loss of control of radiation sources has given rise to unplanned exposures to workers, patients and members of the public, sometimes leading to fatal results.

360. Similarly to the nuclear energy production and the fuel cycle facilities, radiation protection regulations are in place and the regulatory authorities exercise adequate control of radiation sources to ensure that they are used and stored in a safe manner and that sources which have exceeded their useful life are appropriately disposed of.

APPLICATIONS OF IONIZING RADIATION IN MEDICINE, INDUSTRY, AGRICULTURE AND RESEARCH

Major public concerns
(see also Control of Sources of Ionizing Radiation)

- **Are the radiation sources of the installations under control?**
- **What happens if a radiation source gets lost or stolen?**
- **Is it dangerous to work with radiation? Can I have children? What about cancer cases?**
- **What are the side-effects when undergoing medical diagnosis or treatment involving radiation sources? Can X rays contaminate?**
- **Does food get contaminated when irradiated?**

Key messages to be communicated

- The uses of sealed and unsealed radiation sources in industry, medicine, research and agriculture in the country and the safety requirements and devices in place to assure protection of workers and the population.
- The legislative radiation protection framework in place. The basis of the system for notification, registration, licensing and control of radiation sources set by the regulatory authority.
- The existence of an inventory of sources, which is to be regularly verified and made available for inspection by authorized persons.
- The types of warning signs that are installed to clearly demarcate the storage location.
- Manufactures of radiation sources and devices containing radiation sources are responsible for assuring that their products can safely be used for the stated purpose. Mandatory approval of some sources or devices. Specifications are supplied by the manufacturer advising on safe working practices as well as to any limitations on the use of their products.
- The owners or users of radiation sources are responsible for their security.
- Sources, equipment and safety devices are subject to regular maintenance and testing to ensure that they continue to meet the initial specifications. Tests would include leak testing of sealed sources, inspection and testing of source transport mechanisms, and checking for satisfactory operation of shutter assemblies and correct operation of warning systems.
- Irradiation of food for preservation does not contaminate and there is no harm to health.

Transport of radioactive materials

361. Transportation is required in connection with the use of radioactive materials in electricity generation, medicine, agriculture, human health, industry, geology, hydrology and research at both the national and international levels. Transportation of radioactive materials can take place by road, rail, water (barge or ship) and air. The related activities include the packaging, handling, transport and storage in transit, where applicable, of the radioactive materials through to receipt of the materials at the final destination.

362. Safety in the transport of radioactive material is provided to a great extent by very specific regulatory requirements for appropriate packaging of the material. The IAEA transport regulations [8] prescribe packaging requirements for all radioactive materials according to the level of hazard. Very strong packages, known as Type B packages, must be used for transport of radioactive material with high levels of hazard. Type B packages are designed to provide protection from their hazardous contents even in the event of serious transport accidents.

363. The IAEA transport regulations prescribe not only the various types of packages which must be used but also the very specific test requirements for these packages. Designers of transport packages typically include margins of safety in order to ensure that their packages will survive the regulatory test requirements in a manner that is acceptable to the regulatory authorities. These margins of safety will result in a package being capable of surviving accident conditions which go beyond the regulatory test conditions. Many of the theoretical potential consequences are based on scenarios which are used to set limits for the contents of the packages. Type B packages must be able to survive severe test conditions which exceed a wide range of serious transport accident conditions. These test requirements include a combination of impact or crush test, a puncture test and a fire test.

364. Overall, the objective of the transport regulations is to protect persons, property and the environment from the affects of radiation during the transport of radioactive materials.

TRANSPORT OF RADIOACTIVE MATERIAL

Major public concerns

- **What are the origin, type, form and amount of radioactive materials?**
- **How is waste packaged for transport; is it safe?**
- **What is the transport mode and route?**
- **How many trips (daily, weekly, monthly, yearly) will be made through my community/ by my house? And for how long?**
- **How many accidents have occurred during transport? In what country? Was contamination spread?**
- **What danger are you placing on my community with the transport of these materials?**
- **How much more dangerous is this material as compared with other materials transported through my community?**
- **Why is it necessary to transport radioactive material through my community?**
- **How can I be assured that the radioactive materials will be transported safely?**
- **Are the transport personnel properly trained to ensure the safe transport of the waste?**

- **What procedures will be put in place in case of an accident during transport?**
- **Will I be notified in the event of an accident? What precautions should I take?**
- **How can you ensure that the radioactive material will not get into the hands of terrorists to make bombs?**

Key messages to be communicated

- The regulatory authority should explain the meaning of the trefoil sign for radioactive materials and the meaning of the labels used for classification and identification of the package during transport.
- Radioactive material has been transported for many years and such transport now involves millions of packages each year. The safety record with the transport of radioactive material has been outstanding. There have been no serious consequences as a result of the radioactive nature of such material being transported or being involved in transport accidents. This excellent experience is a good illustration of the high level of safety or the low level of risk involved in the transport of radioactive material.
- The radioactive levels associated with the package as compared with natural background radiation.
- The good performance of transport packages has been demonstrated not only in actual accidents but also in simulated accident tests which have included drops of packages for high activity materials from a helicopter and high speed rail and truck crashes. In these simulated accident tests the impact velocities were much higher (up to 396 km/h for the helicopter drop test) than the 50 km/h at impact on a hard unyielding surface as is required in the test requirements for such packages.
- During air transport the probability of a serious accident is relatively small. Furthermore, only a small percentage of aeroplanes would carry highly radioactive material. This makes the probability of highly radioactive material being involved in a serious air transport accident even smaller. And in the unlikely event of such an accident, the radioactivity related consequences are not necessarily serious because of the protection provided by the packaging.
- Special safety measures are provided during transport to assure protection and avoid any diversion of radioactive material.
- The IAEA continues to review and revise its transport regulations to ensure that a high level of safety is maintained or even improved. Revisions take into account the latest radiation protection knowledge as well as experience and technological developments in the transport and packaging of radioactive material.
- International co-operation and systems are in place to effectively control and track the movement of many materials, including radioactive material.

Management of radioactive waste

365. Radioactive waste is produced from a wide range of activities, including the nuclear fuel cycle and the medical and industrial applications of radioactive materials. Radioactive waste is generally categorized as low and intermediate or high level. Low and intermediate level waste derives its name from the fact that its radioactivity is relatively small. Typical items in this category are cleaning utensils such as mops and rags, gloves, laboratory equipment, instruments, process residues, filters or other components used in a radiation area. With low activity or radioactive contamination in comparison with the high level waste. However, the volume of such waste is much larger. High level waste usually includes spent (used) nuclear fuel as well as reprocessed and vitrified waste.

366. Wastes are usually categorized by nature and level of activity, heat content and potential hazards. Their quantities, from country to country, can vary depending on the range of nuclear based activities taking place. A distinction is also made based on short lived wastes or long lived wastes. For short lived waste, the radioactivity decays to innocuous levels in roughly 300 years or less, while long lived waste remains radioactive for thousands of years.

367. When compared in terms of their volume with other industrial/hazardous wastes, radioactive wastes are significantly smaller. Also, the hazard associated with radioactive material decreases with time. Some radioactive wastes from outside of the Nuclear Fuel Cycle are long lived, such as naturally occurring radionuclides, and this poses a hazard for a long time, similar to persistent toxic chemicals [9].

(a) Pre-disposal of radioactive waste

368. A significant level of effort goes into recycling and reusing radioactive material as much as possible so that the amount of waste generated that will require disposal will be as small as possible. The classification and management of the resulting wastes depend on the form and level of radioactivity associated with them and are in strict compliance with standards established and enforced by the regulatory authority. Radioactive waste is managed so as to reduce its volume and to protect human health and the environment [10]. Procedures for the treatment and storage need to be provided and are strictly controlled in a manner that will also be compatible with final disposal requirements to ensure adequate protection. These might include special treatment/conditioning/solidification processes and suitable packaging.

(b) Disposal of radioactive waste

369. Disposal of solid or solidified radioactive waste is the final step which is applied to properly packaged, and, where applicable, solidified/conditioned wastes, in accordance with the regulatory criteria established for the disposal system. A major objective of safe disposal is to isolate the waste from humans and their environment during a time adequate for the radioactivity to decrease to insignificant levels.

370. In general, it is recognized that for most of the radioactive waste, safe disposal methods exist and are successfully operating in a number of countries. The options in use include disposal of low and intermediate level waste in both near surface or geological repositories.

371. For the remainder, high level radioactive waste containing long lived radioactive material, and for spent fuel, these are safely stored and monitored, generally in water filled pools or dry storage concrete canisters either at the plant site or at a centralized location. In addition, work is under way in a number of countries to establish disposal facilities. This would involve in many cases the emplacement of the waste into vaults in deep geological formations complete with a multibarrier system to contain the contaminants for very long time scales.

372. In many countries, legislation has been introduced which makes it mandatory to carry out an environmental impact assessment (EIS) of a proposed disposal project for waste disposal. Such an assessment would include a full description of the proposed project and the anticipated environmental and socioeconomic impacts. An effective EIS should address all likely public concerns that could arise in connection with the establishment, operation and closure of the waste facilities.

373. Safety assessments are based on hypotheses and models. The uncertainty surrounding the assessment of the very long term effects of radioactive waste disposal is a significant issue with respect to determining appropriate courses of action and, for some members of the public, raises the question of whether to proceed with disposal or wait until more is known. The regulatory authorities need to make sure that disposal will only take place if it can be done safely.

PRE-DISPOSAL OF RADIOACTIVE WASTE

Major public concerns

- **Is nuclear waste more or less risky to workers and populations, compared with waste from other kinds of energy?**
- **How does our country manage radioactive waste mixed with organic solvents, corrosive organic products, oils, toxic metals or animal carcasses?**
- **How much waste does a nuclear reactor produce each year?**
- **What are the origin, type, form and amount of radioactive waste?**
- **Will waste come in illegally from other countries?**
- **Will foreign waste be processed in my country? What happens to the waste?**
- **What are the procedures to ensure the safe handling and conditioning of the waste?**
- **How do you ensure that waste is safely stored?**
- **What plans are there for handling waste under catastrophic events?**
- **How will damaged packages of radioactive waste be safely handled?**
- **How will the contamination be removed?**
- **What are the procedures for keeping the community informed of storage activities/plans and emergency situations associated with operations involving radioactive waste?**

Key messages to be communicated

- Explain the origin, type, form and amount of radioactive waste produced and its classification system, and the standards used to ensure protection of the population.
- The regulatory control over all operations associated with the nuclear facility, including the storage of radioactive waste.
- Clear information on the amounts of waste produced by nuclear energy and its risks compared with waste from other kinds of energy.
- State the practice for the safe management of mixed waste.
- Explain clearly how safety assessment processes are made (show exposure pathways).
- Explain policy on import/export waste from/to other countries.
- Monitoring of the facility as well as the workers takes place on an ongoing basis to ensure safe practices are maintained. Control of radiation levels associated with plant activities.
- In the event that an accident takes place, how the public will be informed of the developments during and following the accident.

DISPOSAL OF RADIOACTIVE WASTE

Major public concerns

- **Will foreign waste be disposed of in my country? How? Why?**
- **If there exists some reluctance on the part of political entities, how can we members of the public accept a disposal site?**
- **Why has the waste question not been solved in the great majority of developed and developing countries?**
- **How much is spent on waste disposal each year?**
- **Is the proposed disposal technology appropriate (safe)?**
- **Have other similar facilities been built elsewhere and how are they performing; what are the concerns/views of the communities located near these facilities?**
- **Where will the disposal facility be established?**
- **Can the local municipality veto the establishment of a disposal facility?**
- **Where does the waste come from, what does it look like?**
- **How dangerous will the waste be in the disposal facility and for how long?**
- **Will it be possible to make nuclear weapons out of this waste in the future?**
- **How can one be sure that the containers around the waste will not fall apart allowing the waste to leak out/escape from the disposal area?**
- **How can leaks be detected early so they can be fixed before the environment is contaminated?**
- **Can the wastes be retrieved from a disposal facility if necessary if (a) better technology is developed in the future or (b) if there is a serious leak?**
- **Will it be possible to live on the ground above or near a waste disposal facility once it is closed?**
- **Will the surrounding land and the groundwater be forever contaminated, can it be used for agriculture or other purposes?**
- **Have waste producers set aside sufficient funds to pay for disposal? Who will pay for waste disposal?**
- **Is a long term environmental fund in place to assure any corrective actions?**
- **Are there plans for long term control once the disposal facility is closed?**
- **Who will be responsible for the closed facility in the very long term?**
- **Will the operations of the disposal facility match with the requirements as set out in the EIS?**

Key messages to be communicated

- Explain the origin, type, form and amount of radioactive waste disposed of, the standards used to protect the population. Compare with methods for disposal of other hazardous waste.
- The EIS provides the detail of the proposed waste disposal facility and the potential impacts to humans and the environment.
- A disposal facility, in order to be established, will need to meet a number of strict regulatory requirements based on international recommendations before it can be established. Once the facility is operating, the facility will continue to be required to meet standards to ensure the continuing health and safety of the workers and the public and the protection of the environment. Standards are set in the license to ensure safety and there would likely be a severe penalty if the operator did not meet the standards.

- Explain the characteristics of a near surface repository for low and intermediate waste and the one for high level waste.
- Explain how the Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management addresses concerns about the import of waste from other countries.
- State the roles of the national agencies or others and their responsibilities for the management of the waste facilities.
- Explain the progress made in other countries to safely manage radioactive waste.
- Provide information on how much is spent on nuclear waste disposal each year — in some countries, the authority may want to refer to the operator for more information.
- There are a number of safely operating low level radioactive waste facilities in many countries including Brazil, France, India, Japan, Spain, Sweden and the United States.
- A suitable environmental monitoring programme will be put in place to measure the effectiveness of the disposal facility and ensure that wastes would not threaten the health and safety of the surrounding community.
- Ensure that only safely operating radioactive waste disposal will be established.

Emergency preparedness and response

374. The control of radiation sources aims at protecting man and environment and preventing nuclear or radiological accidents. In every operation using radioactive material, one has to foresee the possibility of an incident or accident, in order to prevent it or to be able to reduce and mitigate its consequences. The range of potential accidents of concern is very wide, ranging from a major reactor accident to accidents involving small amounts of radioactive material. Mobile nuclear reactor installations, such as nuclear submarines, ships and satellites or terrorist activities involving radiation are also the subject of emergency preparedness.

375. Although all efforts are made to keep control of radiation sources, there is a great number of unaccounted sources due to failures in the control system, or after war situations or due to change of responsible organization (as in the countries of the former Soviet Union). Accidents have happened because people were unable to recognize the danger they were incurring in getting in contact with a radiation source, simply because they were unaware of the meaning of the radiation sign or because they did not recognize the source by its characteristics, shape or labels (if any). Examples are the accident in Goiânia, Brazil (1987) [11] and in Georgia (1996 and 1997), or many other accidents with industrial sources [12]. From the lessons learned in past accidents, the medical doctors were unable to make an early diagnosis of radiation related injuries. In general, they are not used to seeing the relevant symptoms and may misinterpret them and delay the application of the correct treatment.

376. Emergency preparedness is usually carried out at two major levels: First, the user or operator must be prepared to mitigate the potential consequences of the accident at the source and to alert external organizations (regulatory authority, Fire Brigade, Civil Defense, etc.). Second, the external organizations must be prepared to manage and reduce the impact to public, in case they are affected.

377. Emergency preparedness for nuclear reactors has established that measures to protect the public and environment are also needed far from the emergency site. The emergency plan reflects the consideration of protective measures that should be weighted for different areas. Moreover, the international conventions are instruments to facilitate assistance and collaboration between

signatory countries. Adequate co-ordination among national and international organizations has also been considered.

378. The response to an emergency requires the implementation of protective actions whenever the radiation dose exceeds predetermined levels. Protective actions can be: evacuation, sheltering, administration of iodine, temporary relocation, permanent resettlement, control of foodstuff and water, etc. During the past decade, considerable progress has been made in developing internationally recognized principles for decisions on protective measures following accidents involving radioactive materials, and in providing quantitative guidance for applying these principles [13].

379. Communication to the public regarding an emergency has two different aspects: In normal situations, communication has to take place to inform and to prepare the public for possible actions that they may have to take. A second communication aspect is during an actual emergency. The public concerns and the messages are different for both, as one is preparatory and the other derives from the very urgent need for information. If communication is not done properly beforehand, as a preparation for accident cases, both messages will have to be sent at the same time, causing disruptions among regulators who will have to deal with the mitigation of the consequences of an accident and to respond to questions that could easily have been dealt with at an earlier stage.

380. While the International Nuclear Event Scale (INES) [14] may assist in communicating under certain crisis situations, it is important to explain the context for the regulator's decision, to label an incident or an accident at a certain level of the INES scale.

381. During an emergency response, regulators should be willing to discuss both bad and good news. Since openness is a prerequisite for credibility, regulators should provide simple and understandable information to media and public, without speculation and without raising more doubts. Section 4 deals with crisis communications, explaining in detail how to communicate during emergency situations.

382. The preparation of detailed reports about an emergency situation and the actions taken to mitigate its consequences are fundamental for future analysis of the lessons to be learned, the identification of the necessary improvements and to maintain consistency with the messages communicated to the public.

EMERGENCY PREPAREDNESS

Major public concerns

- **Is the emergency plan updated, tested and are people trained to understand and respond to the plan?**
- **What to do if there is an emergency situation?**
- **Is there enough assistance and expertise to deal with the situation?**
- **Who will receive iodine?**
- **Will it be it necessary to evacuate? How long it will take to evacuate?**
- **Who will take care of my household?**

Key messages to be communicated

- The frequency of the updates to the plan.
- The responsible for implementing the plan.
- The organizations to be contacted in the emergency situation.
- The technical capabilities available and the programme of training and preparedness through simulated emergency exercises.
- The equipment and material, infrastructure available to mitigate an eventual accident.
- The visual and sound alarms.
- The procedures for sheltering, evacuation, transportation, etc.
- Explanation of the INES system of communicating the safety significance of events at nuclear installations.
- Explanation of the conventions on early notification and assistance in case of emergency.
- Educational campaign to several audiences on the risks of radiation sources and how to protect against ionizing radiation. Emphasis on explaining the meaning of the radiation symbol (trefoil), the physical appearance of radiation sources and shipping containers and a list of contact persons in the regulatory authority for further clarification on the issue.
- Information to medical doctors about radiation injuries, their symptoms and how to handle a contaminated person.

NUCLEAR OR RADIOLOGICAL ACCIDENT

Major public concerns

- **What happened? What are the consequences?**
- **Who is responsible for the accident?**
- **Who will pay?**
- **How much will the population receive for the losses?**
- **Will I die as a result of the accident? (victims)**
- **Is the water, foods, land, money, etc. contaminated?**
- **Who will take care of the evacuated houses?**
- **Are they telling the truth?**
- **Does the annual dose limit apply in case of intervention?**
- **How does one justify the costs of intervention? Who is responsible for the costs?**

Typical questions asked during the mitigation of the Chernobyl accident

- **Is it safe to live here in the Chernobyl area?**
- **What is the dose to the children in rad in an area that has 350 Ci/km^2 (12.95 MBq/m^2)?**
- **Is 35 rem (350 mSv) a dose that one will not die from? What do you think the dose should be? Is there an international basis for the 35 rem (350 mSv) concept?**
- **Could radiation cause throat cancer?**
- **What conditions are acceptable and what not? Why?**
- **Is it possible that incidences of tiredness, headaches, and pains in the joints experienced by people in our contamination zone are connected with the radiation situation?**

- **Can one take locally produced food? What effect do radioactive substances have on subsequent generations?**
- **Are there still discharges coming out of Chernobyl? What effect is this having there?**
- **If we were to move to a clean area, would the radiation we have accumulated in our metabolism be eliminated entirely, and over what period? Are there any products or medicines which remove radiation? Why are they not being used in our zone?**
- **If, as you are telling us, everything is all right here, why is it that the people in our governing authorities or their children are leaving on the quiet?**
- **Who exactly has been checked for radiation, and when? I would be glad if you could name just one resident of our town and say who did the checking.**
- **We have no confidence in the information presented by Mr. X. We would ask the commission to check the data and give us an answer**
- **Is it possible to live in an area where the radioactive contamination concentration amounts to 40 Ci/km^2 (1.48 MBq/m^2)?**

Key messages to be communicated

- A short and clear description of the event and the classification in the INES (who, what, where, when, how).
- The consequences of the accident.
- An assessment whether the public and/or the environment are in danger.
- The emergency co-ordinator and organizations involved in the emergency response.
- Actions being taken to reduce and to mitigate the consequences of the accident.
- Legal repercussions of the accident.
- International assistance in place.
- Contact persons for further information.
- About the accident in Chernobyl: Refer to accurate information such as in Ref. [15].

4. COMMUNICATIONS PROGRAMME ON NUCLEAR SAFETY

FUNDAMENTALS OF NUCLEAR COMMUNICATIONS

401. Communications are a specialized field that should be placed in the hands of trained communications experts who work in consultation with experts from the nuclear area. Just as the control of nuclear technologies is a specialized field, so too are communications. Experience has shown that poorly managed communications contribute to lower levels of safety and to an antagonistic environment in which nuclear professionals lose their most important resource: the trust of their constituents, including political authorities and the public.

402. Internal and external communications are equally important. An effective *internal communications programme* will strive to make the organization a team that clearly understands and respects one another's different yet equally important roles. This will contribute to a more effective organization that can better serve the public interest. An *effective external communications programme* will represent the opinions and expertise of the organization to external audiences thereby reducing or preventing misunderstanding and thus increasing safety. The programme will also try to understand and to present the opinions and findings of these external audiences within the safety authority so that these opinions are reflected in the final service offered to society by the regulatory authority.

403. Most people want to have information about nuclear topics. This interest does not mean that people will seek out information on these topics. People are overloaded with information and must be selective about what they spend their time learning about. Most people only pay attention when they hear about an accident. Therefore it is better to assume an audience knows relatively little — positive or negative — about any particular topic. In many cases they may not have thought about the topic before. The lack of basic information may be surprising to professionals who work with the subject on a daily basis. A majority of people do not know what percentage of their electricity comes from nuclear energy or are even able to recognize the radioactive trefoil sign indicating the presence of a radiation field; this has led to several radiological accidents.

404. Lack of information does not mean that people are ignorant. Each target audience needs to feel that their intelligence is respected. Responding to concerns with numbers like "well, your risk of contamination from a transport canister is 10^{-3}", is too scientific and may be interpreted as cold and uncaring. A simple, factual explanation which puts the situation in context is more effective: "if you stand next to this transport canister for 24 hours you will receive the same radiation dose as an 8 hour airplane flight". People are not impressed with scientific risk assessments which show how safe nuclear energy is compared to other energy sources. They think more about the *consequences* of an accident or radiation exposure than about *the probability* of its occurrence. This is especially true for women who tend to be more concerned about the future. Risk assessment should be explained as part of a context, how it is used to improve safety technology and also in debates with technical specialized audience [16].

405. Just as knowledge of nuclear technologies is needed to reduce the risk of mismanagement of radioactive materials, communication can help to reduce the risk of misunderstanding fed by fear and rumour and consequently increase safety. It is clear that

communications cannot correct a technical error. However, technical excellence is no guarantee against unsubstantiated fear and the reprisals that accompany such fear. The first rule of communications is honesty and transparency in place of silence and suppression. Excellence in operations and excellence in communications are mutually reinforcing concepts.

406. To be truly effective, the message must address not only the listener's wants, it must also address their *often unspoken* needs. Communication connects the message to basic values. These basic values include security, safety, trust, right to choose and freedom.

407. A long-term relationship with one's audiences, nurtured over the years, is among the most important investments nuclear professionals can make. It is the foundation upon which **to build trust**. Without trust and some degree of predictability, one's relationships can be turbulent or even disastrous.

408. A communications specialist should be placed within the executive committee of the regulatory authority to assure their expertise is well integrated into the decision making process of the organization. Experience has shown that not placing communications at the same level of importance as operations, finance, or legal functions can have disastrous effects in times of critical importance.

409. A high level communications expert should be trained with the knowledge of how to use a variety of specialized media, including various forms of writing, speaking to the public, media relations, publishing, community relations, and social science research and programme evaluation to achieve the regulatory authority's goals. Each field requires specialized knowledge as well as a large investment in training. Each regulatory authority will have different requirements, depending on the types of technologies they regulate and on the cultural characteristics of the country. Chart 1 shows a summary of the fundamentals of nuclear communications which are explained in more detail later in this section.

410. The basic objective of nuclear communication from the point of view of the regulatory authority is to keep the public informed about the facts on nuclear safety, and especially, its own role in controlling the use of radiation in the country.

411. To develop a comprehensive communication programme on specific issues, five elements are needed:

(a) Clearly stated programme objectives;
(b) Identification of the audience according to the objectives of the communication programme;
(c) Opinion research of audience(s), to identify the need and the messages to be communicated and the channels of communication;
(d) A management plan with clearly stated goals for each audience that will help to achieve the objectives, and which considers a number of options, and
(e) An evaluation plan to incorporate lessons learned in future planning.

412. Each one of these elements is described in more detail in the following sections. When used as building blocks, these elements will create an effective plan for communicating.

CHART 1. FUNDAMENTALS OF NUCLEAR COMMUNICATIONS

FUNDAMENTAL PRINCIPLES OF NUCLEAR COMMUNICATIONS

1. Organizations that **communicate well are more effective** over the long term than those which remain silent and obscure information.

2. Less can be more: **people look for depth**, not breadth.

3. Communication is a job for **trained communications experts** who work in direct consultation with technical nuclear professionals. The communication function should be **placed at the executive level** within the organization to facilitate information exchange and co-ordination.

4. **Communication must be ongoing and predictable**. It is not possible to establish trust with silence or with communications only when there are problems.

5. **The foundation of trust is truth and openness**, even when the information is an embarrassment. A regulatory authority must develop and protect its credibility just as it protects public health and safety.

6. **Use terms that are simple,** straightforward and easy to understand and avoid "insider jargon".

7. Build **evaluation methods** into the programme and **annual budget** and use the audience's need for information to guide the programme.

DEVELOPING COMMUNICATIONS OBJECTIVES

413. Clearly stated communications objectives should be established and agreed upon within the regulatory authority. For example, the mission of a regulatory authority is to ensure adequate protection of the public health and safety and to protect the environment with regard to the uses of nuclear materials in society. A communication objective that could be derived from this mission is that the authority be recognized by their key audiences as an effective regulator of nuclear technologies that protects public health and safety.

IDENTIFYING THE AUDIENCE

414. Prior to developing a communications plan, it is important to identify and segment audiences and to ask them about their information needs. Different audiences will have different requirements, which then determine which option to select from a variety of communications strategies and approaches. The word 'public' is too general to be of much use in developing a communications plan.

415. Audiences, or stakeholder groups, may vary from country to country. Following is a brief look at the role each typical audience plays and the kinds of information they may need.

In each case, it is best to use a scientific method to measure their opinions rather than to 'guess' for guidance.

(a) The media

Private citizens rely on the media to act as a watchdog by bringing issues to public attention. The media therefore play a crucial role. Some studies have shown that while the public believes that the media often gets facts confused, they also believe they play an important role in keeping public figures and commercial interests responsible for their actions. Most reporters, like the average citizen, do not have much knowledge about nuclear energy issues. A good reporter is willing to listen to all sides of an issue, including industry groups. This is not always the case, and some journalists are advocates of a particular point of view. Even so, they cannot be ignored. In many cases, they present all sides of an issue as equal, without giving weight to scientific evidence. Because the media work on a news cycle, they need to have quick access to information and to high level spokespersons for a regulatory authority. Editors and publishers are also very influential in deciding what information is published and the balance of an article's content. There are many examples of well balanced articles negatively affecting public perceptions because the headline (which may be the only part of the article which is read) is biased.

(b) Government leaders — national, state/provincial, local, international organizations, business people interested in nuclear industry

The role of government leaders is to serve the public interest. This group therefore, usually wants to hear all sides of an issue and to achieve a consensus or compromise position. Because they must become "instant experts" on any topic that comes up in the political process, they rely on many sources to provide them with issue briefs and opinions on these topics. One of their biggest problems is information overload and lack of time to review complex publications. They appreciate clear and concisely-written publications that make specific points in unambiguous terms. Elected officials listen most to their constituents. Business people might also seek basic information if they are interested in financing nuclear industries.

(c) Medical and health professionals

Medical and health professionals are the most credible sources of information to the public. Studies in some countries have shown that, with the exception of specialists who use radiation in their work to treat disease, medical and health professionals often lack knowledge about radiation and its impact on human health. Medical and health professionals can use information about radiation protection and nuclear safety issues to transmit it to the patient. The information may be more effective if it is provided in a newsletter format in which each edition explains a specific issue. They can also use very simple brochures to distribute to their patients, as well as videos to show when asked.

Lessons learned from radiological accidents show that most medical doctors are not prepared to identify the symptoms of the high level radiation exposure. Information material about this could be promoted via medical associations and medical magazines.

(d) Developers, end-users and operators of nuclear technologies (medical and industrial organizations, electricity utilities, and their trade associations)

This audience comprises those people who actively use radiation in their work and who are regulated by the regulatory authority. Communication to 'the customer' of the regulatory authority or the regulated facility should always be on professional terms which maintain the respect and integrity of the regulatory authority. These communications must be transparent to the public to gain credibility by showing the independence of the regulatory authority and also that no favouritism is present.

Individuals in these organizations or retired employees may also be interested in participating in improving the public's understanding of radiation, nuclear technology, etc. However, very often their expertise is in their own specific area of activity and they have no information on more general subjects (e.g. a nuclear engineer working in a nuclear energy plant may not be able to explain radiation protection measures for a waste facility). Nevertheless, they sometimes receive questions and need to give information on other nuclear related topics. They should be encouraged to transmit the facts on nuclear issues in a balanced way and to forward questions not related to their field to respective experts.

(e) Academic/researchers in the nuclear area or third-party experts who are not involved in the commercial uses of the technologies nor with regulatory activities

This group often gives advice to the press and to the public. They are often considered neutral experts. It would be useful to establish a working relationship with this audience so that they can assist through interaction with the media and the public. The second paragraph of item (d) also applies here. Communication with nuclear experts always requires strong scientific based arguments.

(f) Academic/teachers not from the nuclear community but experts in related disciplines

Academic teachers are an important source of training and information for young people. Stimulating research and development and encouraging students to consider the job possibilities may be important to maintaining or building expertise in the nuclear area and for the regulatory authority.

An Internet home page and interactive training in nuclear topics via CD-ROM can be effective for students, and is increasingly important for many people worldwide.

(g) The regulatory authority (internal communications) and non-nuclear regulatory authorities (external)

It is important to keep internal audiences informed and apprised of key decisions, messages about nuclear safety procedures as well as the process for handling requests for information. It is also important to co-ordinate with other professionals in the field of regulation to exchange information, to learn lessons from one another, and to co-ordinate messages when necessary.

(h) Special and public interest groups, consumer groups, other non-profit or non-governmental organizations and aboriginal interests

Special and public interest groups are linked to specific constituencies that are often activated to achieve goals. Special groups include organizations with a specific interest, which is often tied to their livelihood or to a demographic characteristic they share in common. They may be able to assist in conveying important nuclear safety information to specific audiences. Public interest groups are those which claim to represent some aspect of the public interest and usually have a membership constituency to demonstrate their legitimacy. They include consumer and environmental groups, and anti-nuclear energy groups. Labour Unions may be another key target for messages. Environmental groups and anti-nuclear groups may be very useful sometimes in pointing out deficiencies that must be corrected. However, they should receive constantly factual information on current nuclear issues to avoid any misconception. The young generation working in the nuclear area attracts special attention from NGO's for not being tied to interests other than the technical ones and for speaking the same informal language.

Aboriginal groups are in some countries an integral part of dynamic ecosystems, for whom to separate 'man' from 'nature' is a convention with little meaning when dealing with environmental impact. The native cultures stress "seven generations" as a reference for accountability. Science and all forms of knowledge are useful and desirable, but human experience and wisdom accumulated through generations remain the basis for judgment. Questions related to radioactive waste disposal may be challenges for them.

(i) Citizens

Nuclear technologies exist and operate only to the extent that private citizens give, at minimum, their passive consent. If a majority of citizens come to believe that nuclear technologies cannot be operated in a manner that protects their health and safety the technologies will either be terminated or modified to be made safe in their perception. Usually, citizens rely on a variety of sources of information when making up their mind about issues. Television in particular has the greatest reach and a very strong influence in setting the public agenda and in framing how private citizens think about information. Those who contact the regulatory authority may want answers to very specific questions. Answers can be formulated for each specific case and can be drawn from a Q&A database to make this process more efficient. The needs of the public living in the neighbourhood of a nuclear facility who receive benefits from it, such as jobs, education, and health services will be different from needs of the public living in a more distant community.

CONDUCTING OPINION RESEARCH OF AUDIENCES

416. The assessment of an audience's knowledge and needs is an ongoing interactive process that helps to establish a long term relationship with your target audiences. As you learn about your audiences using responsible methods, you will begin to understand their opinions, values, priorities, levels of knowledge, perceptions, beliefs, and expectations. You can learn how their opinions compare to yours, how their opinions have changed over time, and why. And, you can learn how they interpret your communications and word choices.

417. Many times an organization believes that its image is X and yet independent research demonstrates that the general public believes Y. Undertaking this initial assessment can save both time and money because it focuses attention on the target audience's requirements and not on what the regulatory authority believes are the needs of the target audience.

418. Understanding one's audiences allows one to be proactive instead of reactive. Early identification of questions and concerns will help prioritize and focus communications on **what is most important to the audience**, therefore increasing communication effectiveness and minimizing misunderstanding.

419. Reliable data can be collected using scientifically proven public opinion research methods. Opinion research is a form of public consultation. Good quality opinion research is collected by specialized opinion research firms who adhere to the standards of the practice. Good quality research can provide information that can focus communications on the audience's needs and can be used to evaluate specific communications tools as well as an overall communications programme. Poor quality research is not conclusive. Generally, it is advisable to work with firms who are members of the World Association for Public Opinion Research (WAPOR) or similar organizations. In addition, because nuclear energy is a specialized field and opinion research can be costly, it can be helpful to work with an opinion research firm that has experience in studying nuclear energy issues and in explaining how to apply the research. Many research methods can be used alone or in combination, depending on the objective of the research. Chart 2 lists the elements of an opinion research and some the methods for each element.

420. Although this process requires an investment of time and resources, it has been found to be a worthy investment in order to create an effective programme that is guided by scientifically based research and programme evaluation.

421. Before conducting primary research, it is wise to ask your survey research firm to do secondary research analysis by collecting all publicly available polling data on nuclear technologies and knowledge about the specific audiences.

422. Preliminary programme objectives should be developed prior to conducting the baseline survey. Performance indicators can then be developed to monitor and to identify what needs to be done to achieve the objectives. This information will be used to set specific programme goals. An annual survey should be conducted as part of your programme evaluation (this is discussed later in the section).

423. It is important to recognize that there are a number of techniques that are **not reliable or projectable to the larger public**. This includes research in which the people who participate are self selected, such as a mail-in questionnaire or an e-mail questionnaire.

424. The first step after collecting the opinion research data and understanding each audience and their issues, is to develop a baseline understanding of perceptions of the regulatory authority from the results of the opinion research. This analysis may reveal that certain target audiences have widely different perceptions or images of the regulatory authority. It is important that this initial research be prepared by independent and neutral analysts. Once this analysis is completed, a management plan should be implemented.

CHART 2. ELEMENTS OF AN OPINION RESEARCH

The basic elements of an opinion research are:

- Identification of the problem (a real need to get the desired information).
- Definition of the objective (which information is needed).
- Methods of research
    - exploratory — preliminary studies; or
    - descriptive — describe the situation.
- Methods of data collections
    - observation;
    - one-on-one interview in person;
    - telephone interview;
    - mail survey;
    - focus groups).
- Preparation of questions:
    - list important points and check if they are within the objective of the research;
    - use audience language;
    - simulate the answer to check for ambiguity on lack of alternatives;
    - check format and content;
    - test the questionnaire;
    - several types of questions, scales.
- Techniques of sampling:
    - probabilistic — simple and stratified systematic and in groups; or
    - non-probabilistic — by convenience or by judgement).
- Statistical calculations; Gaussian distribution.
- Field work — planning and training.
- Data analysis — encoding, database.
- Representation of results — percentages, graphics, diagrams.
- General assessment and conclusions.
- Recommendations.

425. Once the foundation is established by knowing the communication needs, programme specific objectives can be elaborated and a management plan can be developed which incorporates the following elements:

(a) Development of goals for each audience;

(b) Message development;

(c) A designated spokesperson responsible for communicating the message;

(d) Which communication vehicle is appropriate for the message;

(e) A schedule for releasing the various messages;

(f) A crisis communication plan;

(g) A communication plan during the siting of nuclear facilities.

Developing programme goals for each audience

426. The **programme goals** for each audience should be defined at the beginning of the programme based on research findings. The goals should be realistic and, where possible, quantifiable. As the financial resources available to the programme will also be a factor in its success, the scope and target audiences and the means of addressing these audiences should all be considered. Unreasonable goals, such as increasing public acceptance for a waste facility by 50% in one year, will undermine the credibility of the programme. Realistic goals which can be evaluated in specific measurable terms are also important for securing the funding necessary to continue the programme. Goals can be modified as needed to achieve objectives.

Message development

427. It is useful to identify all important messages that the regulatory authority considers important (in priority order from most important to least important) and work to write each one in simple language separately as a one-sentence statement. These messages can be tested by professional interviewers using personal interviews among a random sample of 100–400 people that is matched to the characteristics of the larger population. A useful method is to put each message on an index card and ask each respondent to rank the cards from the most important message to the least important message, and ask why. This will help the authority to prioritize which messages the public considers most important and to understand if the messages are understood or if they are confusing. In addition, it is also useful to do the same thing for messages of the critics of the regulatory authority, and to develop careful answers for each one. This will help the authority to think through the criticisms carefully and to assist communications personnel in answering criticisms of the authority. Section 3 is designed to provide a basis for creating regulatory messages about safety.

428. Sometimes as a result of an event, possibly in another country, an issue will emerge as important to the public. There may be one key issue or a series of issues that need to be addressed. The results of the surveys may reveal issues which cannot be addressed through communication alone as they may affect national policy or foreign relations. Nuclear energy and waste repository subjects in particular are controversial and the public may react emotionally, out of proportion with any potential physical harm they might incur. Timely information from credible experts can diffuse a situation before it becomes a crisis. How a message is to be

delivered may impact on the public's ability to understand the message and should be considered when developing the message.

429. The programme must be designed flexibly to accommodate changes in the target audience views or opinion on any particular message. The message may change due to shifts in public opinion, activities of the industry or pressure groups, among many factors. For example a local community may be enthusiastic about hosting a waste treatment plant because of the initial perception that a new industry in the region will create jobs and economic development. The arrival or creation of an opposition group may shift the focus to environmental issues. Thus the local population may initially have had one view, and as time passes segmentation of public opinion may develop, which in turn will require specialized messages. Greater openness in many country's decision-making processes, especially regarding licensing and siting of nuclear facilities, will have an impact on a communication programme.

430. It is possible to prepare a single message for multiple target audiences. However, information that may be critical to provide to political leaders may have to be reworded for the media. A message for the general public should be prepared with their concerns and education level in mind. For example, women and young people have different values and concerns and therefore messages need to be framed in such a way as to let those audiences understand your message. A system or procedure for measuring the impact of the programme on each target audience should be established so that its effectiveness can be evaluated throughout the year.

431. Technical language is not easily understood by the public. Examples include:

(a) terms such as effective dose, shielding, interlocks, half-life, radionuclide, gamma rays;

(b) abbreviations and acronyms, such as ICRP, PWR, ^{60}Co, TLD, and LDM;

(c) units and prefixes Bq, Sv, nano, micro, mega.

432. Indeed there is some evidence not only that people do not understand technical terms, but that some terms are understood to mean something quite different from what is intended. These are often words that are in common use with a particular meaning, but have been applied to nuclear technology with a different meaning. Examples of this include:

(a) the term 'going critical' describes a reactor starting up normally, but the word 'critical' more commonly indicates something going wrong (similarly 'critical group' or 'critical health conditions');

(b) terms such as 'passively safe' are used to describe reactors with safety systems designed to operate by natural forces, but 'passive' carries connotations of laziness or lack of vigilance.

433. Difficulties in understanding technical language can be exacerbated when the terms are translated from one language to another, whether translating from international recommendations (most commonly expressed in English) to a national language, or between different languages used within a country. Examples include:

(a) two English words to which subtle different meanings have been attributed in international guidance, but which would normally be translated to the same word in other languages, e.g. 'safety' and 'security', 'limit' and 'constraint', 'acceptable' and 'tolerable' (this is further complicated by the fact that, in other cases, different terms are used to designate exactly the same item or concept, e.g. 'radiation protection', 'radiation safety' and 'radiological protection');

(b) words which, when translated to the closest term in another language, acquire an unintended change in meaning, e.g. 'contamination' becoming 'poisoning', 'acceptable' becoming 'safe'.

The spokesperson

434. It is vital to the credibility of the regulatory authority that only authorized persons represent it before the public and the media. Unauthorized personnel, if confronted by someone from the media, should refer the journalists to the authorized spokesperson. Certain situations may require specific responses from key individuals. In some cases only the top official can make statements on behalf of the agency. In other cases someone with a specific technical expertise may be required to respond to a specific event, such as a radiological emergency. If the regulatory authority has employed communications specialists, they should be kept informed and allowed to co-ordinate all responses so that conflicting or contradictory messages are not issued to the public. It may be advisable to provide special communication training to selected technical staff in order to familiarize them with methods of communicating to the public and responding to hostile media questions. Above all, once a message has been approved, everyone must communicate that message and that message only, until a new message is approved. It may be necessary to create a formal but timely system for approving messages. Once the need to issue a message is determined, a clear hierarchy of who is responsible for drafting the message, verify facts and grant timely and final approval, needs to be established.

Communication methods

435. The common methods of communication are:

(a) Written communication (may include press releases, fact sheets, reports, studies)

(b) Oral communication: speeches, briefings (on and off the record)

(c) Visual communication: graphics, videos, films (a picture is worth a thousand words — this is very important)

(d) Direct interaction: interviews

(e) Computers: e-mail, Internet

(f) Visits, tours, special events (first hand experience is the most important communications tool)

(g) Training seminars.

Written communication

436. One of the basic forms of written communication is the press release. It has a standard form which is followed by most writers. Annex B shows examples of press release. The press release includes the intended date of publication (which is not always the day of release), the location of the organization issuing the press release and a contact person at the issuing organization. The first paragraph always includes the most important point, where the 'news' should be stated. Follow-up paragraphs should explain or elaborate in sufficient details to make the point. For print media, if it is possible to personalize the information, i.e. if the spokesperson or the responsible official can be quoted as saying the 'news', the quote will make it more interesting to the reader. A press release should be as brief as possible, normally one page, at most two pages. Although communications professionals involved in nuclear topics prefer the written form of communication because it is possible to better control the message and to provide precise details, it is not necessarily the preferred method to communicate with the public.

437. A good practice is to have a collection of good quality press releases on many topics. They can provide some ideas for the elaboration of a press release.

438. Other forms of written communication such as fact sheets can be prepared in advance and provided as background information to respond to inquiries. For example fact sheets could be prepared which describe the licensing process for a facility. Fact sheets should be very short and

simple, prioritizing the key points in the headings. Fact sheets are also available from the IAEA on various subjects related to the peaceful uses of nuclear energy and nuclear safety.

439. Brochures or reports have many advantages when trying to communicate with select audiences. Topics can be covered in more depth than a press release and photographs or charts and figures can be included to illustrate the subject. The quality of the design and layout are important. The image of the regulatory authority as a professional organization will be undermined if a brochure is poorly designed or written. The reverse is equally true — a well written, thoughtfully designed publication can enhance the opinion of the author in the mind of the reader.

440. Distribution of printed materials is vital to the success of the communication programme. A list of accredited journalists can be obtained from a local media association for free or a nominal fee. Depending upon the content of a brochure or report, its availability can be announced in the media, or distributed through government publication centres, or direct mail within specific locales. Special events, seminars or conferences may be another venue for publication distribution.

441. All published materials should be tested using a research method (in some countries, a group selected from the target audience may be interviewed to comment on the publication prior to its mass production and distribution) to determine their effectiveness in communicating the intended message. This information will help assure that the communication materials work as they are intended. It is a waste of resources to provide information that does not communicate effectively and that has not been reviewed by the intended audience to determine if all their questions have been adequately answered and if they understand the terms and the language. Experience has shown the value of building in a simple research process into the budget.

Oral communication: speeches, briefings, etc.

442. Any request for a speech is an opportunity to enhance the image of the regulatory authority. As part of the regulator's work speeches or presentations must be given to a variety of audiences. The national parliament may request testimony when planning for the annual budget. Community groups may request a speaker to discuss future licensing of a nuclear facility in their region. It is important to select an appropriate speaker for the audience (see para. 434). Speakers should be selected who can relate to the needs of the audience. Speakers must also have sufficient knowledge of a wide range of subjects to be able to answer questions competently and convincingly. If an audience may have members who are hostile to the speaker's topic, the speaker should have the temperament and training to withstand difficult and intense questions in a calm, courteous and professional manner.

443. Any request to speak with groups should be carefully reviewed so that the message is appropriate to the audience and it furthers the goals of the authority. The text of any presentation should be reviewed internally prior to the speech in order to ensure the consistency and credibility of the message. If it is a presentation that is likely to receive a lot of media attention and will be followed by questions from the media, it may be appropriate to prepare a list of likely questions and answers and to practice taking questions from several people in order not to be surprised during the actual event.

444. People learn information or receive messages by a variety of means, some prefer to learn by reading, others by listening and another group by actually doing the task, or a combination of all the above; good speakers choose words that allow listeners to create a mental picture, stimulate the auditory sense by creating similes 'it sounds like' and using other words which have a more emotional content. If possible a speech may be illustrated with graphics and/or music.

The more actively the audience is required to participate, the more likely they are to remember the information.

445. We are living in a world where most of us experience sensory overload. In order to survive this data overload, we delete, distort and categorize the information we receive. In order to be a successful communicator we need to analyse how the audience is responding to our information and continue to adjust the message until it is received.

Visual communication: graphics, videos, films

446. The saying "a picture is worth a thousand words" comes from the advertising and public relations industry. Concepts that are obvious to an engineer may need careful illustration in order to be comprehensible to the public. When creating messages it is important to choose words that create the visual image which is accurate in the listener's mind. Deciding the target audience at the beginning of the project is crucial to producing a successful video. There is a public acceptance problem with radioactive waste storage partially because the public has an image of the waste as a highly toxic liquid that could potentially leak and harm people and the environment. People need to be informed about basic data like the colour and form of waste, the fact that prior to permanent storage it is made into a solid material is also not widely known. Actually viewing the waste and the inside of a storage facility may be much more convincing than a printed brochure as it can demystify the image of waste received. In the same way a video of a crash test or a drop test accompanied by a simple explanation of the criteria for a container is much more effective for explaining safety during transport of radioactive material.

447. Films and videos can be extremely effective in conveying concepts such as safety in an entertaining and informative manner. The quality of the product is very important. A professional video production company should be engaged to produce the film or video. Most audiences are accustomed to viewing cinema and television programmes of very high quality. Younger audiences being more familiar with computers and computer games have a different attention span and have grown accustomed to taking in bits of information in very short bursts which may seem disjointed to older audiences. In order to avoid losing the attention of younger people, it is necessary to present the information in brief colourful displays and change the volume of the background sound or voice with each segment.

448. Distribution of the film or video is key to the success of this method of communication. In order to be effective it must be seen. If the target audience is young people, it may be worth discussing a project with the Ministry of Education or the organization responsible for educational curriculums. Television companies or independent producers may also be interested if the film is in an attractive format. A 30-minute or hour-long special during prime time on TV can reach more people than any other communication activity. In some countries TV stations are required to provide free access for public service announcements. It may be possible to arrange for safety messages from the regulatory authority to be broadcast to the general public. If certain audiences such as local politicians or academics are the targets, a special seminar, workshop or informal reception can be organized with the film or video as the main presentation, followed by a question and answer session.

449. Many of the newer audiovisual systems now allow a presentation to be shown directly from a computer screen. Aside from the expense of purchasing this equipment, which may be prohibitive in some countries, these systems have the advantage of flexibility. A presentation can be organized for each target audience and updated as necessary. It is also possible to create a slide show with a taped musical/voice presentation, which is almost as sophisticated as video. These shows have the same advantage of flexibility and freshness, which a video may lose over time.

One word of caution, these presentations will require a greater technical sophistication on the part of the presenter in preparing and timing of all the audiovisual equipment.

450. All videos should be tested with the target audience to determine the effectiveness in communicating the message prior to finalizing the video and to distribution.

Direct interaction: interviews

451. There are various types of interviews which may help provide information to the public. Live interviews may or may not be scheduled in advance with TV or radio journalists. Pre-recorded interviews may be formal or informal but will be edited before they are broadcast. Background interviews are for journalists to understand a subject in more depth and may or may not be used in a report to the public.

452. There are certain basic rules that most journalists follow in interviews:

(a) Everything you say is 'on the record'; even if they promise a statement will not be used. This is not necessarily so, hence speak only on topics or subjects with which you are comfortable and which can indeed be printed on the front page of the newspaper, with your name quoted as the source of the information;

(b) You are entitled to polite behaviour: no one has to tolerate rude, inappropriate questions and you are entitled to say what you have to say without interruption;

(c) Journalists must identify themselves, their employer and the subject of the interview;

(d) You can control to a certain extent the environment where the interview takes place. You do not have to consent to doing an interview while at home or standing next to your car in a busy street. It is perfectly acceptable to ask them to set up an appointment, at a mutually convenient time, in a mutually convenient location;

(e) You are entitled to know if other people will also be present at an interview, who they are and the order of people being questioned;

(f) You are entitled to know if an interview is taped, if it will be edited. If it will be edited, you can ask to review the interview prior to its publication. (You may not be able to change the contents before publication but at least you can prepare for the reaction if you are not happy with the content.);

(g) If you need an interpreter make sure a professional competent in both languages is available. Use your own interpreter not the media interpreter. An interpreter can act as a buffer, helping you to slightly alter the meaning of questions or responses, even if you understand the language of the journalist, having a little extra time to prepare and make sure if an answer is a good idea.

453. In preparing for an interview, the spokesperson or designated representative of the regulatory agency should be aware of the following suggestions. Print journalist interviews may be more relaxed because the time pressure is not immediate. Find out as much information about the interview — who is conducting it, where will it be held, what is the topic, etc. before you agree to be interviewed. The journalist may indicate they are working on an article for publication by a certain date and they would like an appointment to discuss a topic for one hour. TV and Radio journalists may have much shorter deadlines. They may conduct an hour-long or 15-minute interview which will be reduced to less than one minute when it is broadcast! Journalists may like to create an atmosphere of urgency — this is their problem not yours. Take all the time you need to think about an answer before responding, do not be pushed into a hurried response because of their schedule. Because of time pressures, do not allow a journalist's questions to distract you from your main message. Chart 3 shows 'the ten rules of communications during an interview'.

454. No matter what has happened (you are being interviewed after an accident) or what questions are asked, respond in a polite professional manner. Remember most people watching TV are not paying any attention to the content of the message — they are watching **how** it is said. Staying calm is not the same as being cold or distant or appearing unfeeling. Appearing passionate or emotional is appropriate in certain circumstances as long as it strengthens the spokesperson's credibility and professional bearing.

455. Although many journalists are neutral fact finders trying to develop a balanced story, a minority does not always adhere to these goals. Annex C shows a list of hostile questions and suggestions for avoiding the traps they present.

456. *Body language is important.* People notice if a speaker's body language is congruent with their speech. If you want to be trusted and credible, you have to act in a trustworthy manner. This is not easy to do in situations of high stress like TV interviews. Many people make common errors like shifty eye movements or tapping a foot, which under normal circumstances would be seen as releasing nervous energy but on TV appear to be evasive, shifty or impatient behaviour.

457. There are media training courses in many countries, which allow people to practice interview techniques. If this is not an affordable option, practice asking and answering questions on video, review the tape and ask others to critique the performance. Always look the interviewer in the eye, never look at the camera. The journalist is responsible for setting up the camera, you should try to ignore it.

Computers: e-mail, Internet

458. The World Wide Web has created many new opportunities for communicating with audiences around the world. As the Internet has developed it is slowly moving from the computer specialized environment with its own special language and symbols to a more mainstream form of communicating. However, certain rules from its origins within the computer community still apply. If creating a Web site or home page is contemplated, it is important that messages placed on the Internet be developed with this audience in mind. They want information *fast,* in screensize *bits*, which are presented in a *graphically interesting* manner.

459. The regulatory authorities of some countries have Web sites on the Internet. Licensing publications and an explanation of procedures as well as public publications are available on their Web site. Special software can be installed in the site so that publications are easy to research, locate and print quickly. Time is money on the Internet, and if publications are not easy to locate or take too long to download, visitors will become frustrated and stop visiting the site. Web sites also require a certain amount of updating so that the information continues to be fresh and interesting. A section of the Web site can be used to post recently issued press releases or reports. Links between sites are a primary tool for navigating on the Internet and as more organizations create Web sites, links must be continually checked and maintained for accuracy.

460. As part of a Web site, an e-mail address can be publicized which allows the public to ask questions, or request more information about an activity. E-mail is a fast and an efficient means of communicating with people. Over time an analysis of the type of questions and topics which occur most frequently may help target messages and audiences better.

CHART 3. THE TEN RULES OF COMMUNICATION DURING AN INTERVIEW

1. **Be Yourself and Straightforward**

Avoid fancy, pretentious language. It does not impress anyone. In fact, it confuses people and cuts you off from the audience.

2. **Be Comfortable and Confident**

Relax and remember that you probably know more about your subject than anyone in the audience. Stay calm no matter what has happened.

3. **Be Honest**

If you do not know the answer to a question, admit it. Your credibility is crucial. Do not jeopardize it. If you have bad news to say, do it. But provide information about what is being done to solve the situation.

4. **Be Brief**

Keep it short and simple try to make your point in 30 second sound bites. You will look and sound better if you get right to the point, avoiding technical language.

5. **Be Human and Sensitive**

Understand someone's concerns. Explain the situation as if you were part of the story. It promotes a friendly and confident image.

6. **Be Personal**

Personal stories and anecdotes help get across an idea or concept. The audience remembers the key points because of your personal insights. Do not be afraid to use humour in the right place.

7. **Be Prepared, Positive and Consistent**

Keep your goals in mind and stick to them. Control and focus all of your material.

Decide what (maximum) three points you wish to make in the interview and stick with those three points **no matter what the question is**. Play your aces! Do not waste time with scientific background, etc.

8. **Be Attentive**

Concentrate — do not be concerned with any distractions. Listen carefully to any questions asked. Say what you mean and mean what you say.

9. **Be Energetic**

Use gestures, facial expressions and body language to add vitality to your words. Keep your voice conversational but imagine that it has a 'face' which can show different emotions and expressions.

10. **Be Committed and Sincere**

Speak convincingly. Do not be afraid to pause. Every time you open your mouth, look and sound as if you really care.

Visits, tours, special events

461. It is one of the most important communication tool. Most people learn best when they learn through first-hand experience.

462. While it may not be possible for security, safety or confidentiality reasons to permit the public or press to participate in an inspection or tour of a nuclear facility, there may be other regulatory opportunities to open the work of the nuclear installation or of the authority to public view. Activities such as testing a nuclear transport container in a water submersion or aerial drop test could be opportunities for select journalists and photographers to witness the safety systems. High school students may be interested in accessing the computers which monitor some of the environmental data at an interim waste storage facility and perform basic calculations for a science course. The regulatory authority may design a commemoration ceremony or choose to celebrate an event such as an anniversary, which offers an opportunity to involve a target audience and the media.

Training seminars

463. Many regulatory authorities offer training seminars on a variety of subjects. Training and practice help technical specialists learn better skills. A training course for journalists may help them understand better the nuclear safety issues and therefore avoid incorrect messages in the newspaper. The same is true for teachers and their lectures.

464. A one day training seminar for medical professionals, journalists, teachers/academics on the control of radiation sources in the country would provide these professionals with an adequate technical support that would enable them to respond to queries in the event they are contacted and need to inform the public on nuclear issues. Suggested topics are:

A. Basic concepts of ionizing radiation (1 hour):
   (a) Types of radiation and their interaction with matter;
   (b) Sources of radiation (natural and man-made);
   (c) Quantities, symbols and units used in radiation protection;
   (d) Biological effects of radiation.

B. Regulatory responsibility to protect the population (1 hour):
   (a) Brief on the nuclear installations in the country, as well as the applications in medicine, industry, agriculture and research;
   (b) Control of radiation sources: notification, authorization process, inspection, enforcement;
   (c) Monitoring of radiation — demonstration of the use of radiation protection equipment.

C. Emergency planning, preparedness and response (1/2 hour).

D. The role of medical professionals, journalists or teacher/academics in communicating nuclear issues (depending on the specialization of the participants) (1/2 hour).

E. Discussion of any other topic of interest (1 hour).

Communication schedule

465. A good communication programme should be able to schedule most of the routine activities for the next year. Governmental practices differ in each country, and many governments may require the publication of an annual report or status report, as well as a budgetary report. Other routine work like employee appointments or promotions will be conducted at certain set times of the year. All of this work can be scheduled well in advance of its realization. If certain activities will be a major focus for the year — for example a first-ever license for an interim radioactive waste storage facility, the communication programme will need time to prepare video or audio material, and therefore a schedule can be determined by matching the licensing process with the time required to produce a video. Setting up a schedule for the next year and including consideration of unforeseen activities will allow a schedule to be prepared which may balance the routine communication activity in a better manner. If the government's budget cycle causes most of the work on an annual report and personnel decisions to occur in the spring for example, preparation for a waste storage video could begin in the autumn, allowing better allocation of staff resources, so that if a crisis were to occur in either the spring or the autumn, it would not disrupt all of the normal communications plan.

466. As mentioned above, the timeliness of communication, especially during an incident is critical. It is important to understand the deadlines of the journalists working on the story in order to be successful in getting the message to the public on time. Print journalists may have daily, noon/ evening or weekly or monthly deadlines, depending upon when the newspaper/journal is published. TV and radio correspondents also have deadlines. It is important to have a basic understanding of these schedules to plan that if a message is to be released on a timely basis, it is received by the journalists in sufficient time for them to print or record it. If a journalist telephones to ask for information it is always appropriate to ask what is their deadline. In a similar fashion it is possible to manage the news to limit the amount of reporting. If the impact of a message may cause undue criticism of the regulatory authority and higher anxieties and is possible to delay its release without any detriment to the public, then consider doing so.

467. In order to establish a relationship with journalists, some communication professionals hold regular (either weekly or monthly) briefing sessions. This enables journalists to ask questions and become more educated about subjects so that if an accident occurs it is easier to communicate because some common framework for understanding nuclear topics has been established. One advantage to these sessions is the opportunity to establish a level of trust and credibility. Emergency situations and press conferences will by definition be more formal and thus more difficult to manage if the media are perceived as 'a pack of journalists', all of them demanding answers, rather than as individuals with their own personalities, concerns and points of view.

468. Someone should be designated to monitor media coverage of any given event. As it is crucial not to cause public panic, any misunderstanding or reports which are not based on the facts as stated in the approved message, should be responded to swiftly. Direct telephone conversations with the journalist responsible may be sufficient. Sometimes the false report is due to misunderstanding or poor editing, in the rush to publish something quickly. If the reporter or editor does not volunteer to correct the article in subsequent editions of the newspaper or TV coverage, a meeting with a publisher or owner of the publication may be appropriate. Some countries have laws about sensational media coverage and therefore journalists are more careful about reporting facts. Rumours should also be dealt with quickly and efficiently.

Crisis communications

469. A crisis is an unplanned and unexpected event which triggers a real, perceived or possible threat to life, health, safety, the environment, financial status or organizational credibility.

470. While most nuclear facilities may have an emergency management plan, only a limited number of them have a communications plan for coping with the information needs of the media, politicians and the public.

471. In order to prepare for the unexpected when creating a communication programme, along with planning the normal daily communications such as personnel announcements, routine activities etc., a crisis communications plan with a regularly updated list of key personnel with office and private phone numbers should be prepared. An established relationship with all of the organization's stakeholders (interest groups/audiences) based on credibility and trust is the best insurance policy for handling communications during a crisis. There is a distinction between pro-active messages whereby the authority routinely releases information as a means of informing the public, and reactive messages whereby the authority responds to inquiries from the media or the general public. A successful communication strategy will enable the regulatory authority to respond to a communications crisis while maintaining its overall goals and messages.

472. A crisis always contains a number of factors:

(a) It happens with little or no warning

(b) There is little or no data, especially in the beginning of the event

(c) Data can be constantly changing, incomplete or contradictory

(d) There may be physical damage or human injuries

(e) Confusion reigns

(f) Normal communication procedures do not seem to function

(g) Murphy's Law applies — if anything can go wrong, it will go wrong.

473. Despite these factors a crisis does not necessarily mean disaster. Crisis handled in a calm competent professional manner can enhance the regulator's image with the government, media and the public. Preparation is crucial.

474. It is possible to create a list of potential crises. Gather a group of employees together and brainstorm. Let the imagination run wild with worst case scenarios. No idea is too crazy to consider — everything from the Director of the regulatory authority being arrested or dismissed to an inspector on duty being caught playing computer games on the Internet. Once a list of scenarios is prepared, the basic strategies for responding to these events should be developed. Spokesperson or persons should be designated. A system of 24 hour responsibility for responding to media inquiries to a crisis for every day of the year should be established and circulated to all employees. Have a practice drill. If the spokesperson is a communication professional and the crisis is of a technical nature, identify which employees with a technical background are responsible for co-ordination of message development.

475. The spokesperson has to be accessible. Often in an emergency, the responsible officials are working on the emergency, they do not have extra time to deal with the families of the injured or the media. Each person in the organization must know their responsibilities during a crisis. One task of a regulator is to help convince the public that everything is under

control. To maintain the public's trust is vital, and order must be restored as quickly as possible. Setting up a special room with the appropriate resources, like telephones, faxes, computers etc. so that the spokespersons are accessible for the media during a crisis is important. The crisis communication programme implemented during the mitigation of the consequences of the Goiânia radiological accident is described in Annex D.

476. Another aspect of preparation for a crisis is planning to inform the media. Press materials can be published in advance and held for a crisis. These materials can include fact sheets on generic safety issues, description of the lines of responsibility in the regulatory authority, photos, maps, biographies of key officials, contact list of responsible spokespersons with telephone and fax numbers. See Chart 4 for crisis communications guidelines.

CHART 4. GUIDELINES FOR CRISIS COMMUNICATION

1. Only the authorized spokesperson may issue press releases or speak with the media. At the beginning of the crisis the name or names of these spokespersons should be announced and no other person should speak with the media.
2. Only factual information should be provided. Journalists may ask for guesses or speculation, avoid responding to those questions.
3. Some information needs to be withheld pending notification of the appropriate parties. For example, the names of injured people are withheld pending notification of their family.
4. Information which has legal or political implications should be handled by the appropriate authorities.
5. Information should be provided as quickly as possible in a frank and honest manner. The initial statement by a regulator immediately after an accident can be the most important in terms of credibility. This statement should be prepared and approved by the appropriate designated officials.

Communication plan for the siting of nuclear facilities

477. Traditional approaches to siting controversial facilities such as disposal facilities for radioactive waste have shown that public acceptance is unlikely when siting decisions are imposed, where the fairness of siting process has been questioned and where surrounding communities have not effectively been consulted or involved in the decision making process.

478. In siting, construction, decommissioning and eventually closing a disposal facility, the regulatory authority must be in a position to answer the concerns raised in connection with established standards and to point out the procedures to be put in place to ensure safety.

479. Shared decision making is a key consideration and is meant to take account and address the full range of community concerns and preferences. Shared decision making can apply to such things as deciding the scope of characterization, determining the criteria for acceptance or rejection of areas or sites for detailed investigation; identifying and evaluating potential effects on human health, the natural environment and the socioeconomic aspects; developing programmes for managing those effects; and developing plans for monitoring environmental effects of the plant operation.

480. The regulatory authority can be helpful to the community in ensuring that it has access to the information required to evaluate safety. Information about the organization's plans, activities and progress needs to be available to the public from the beginning of the siting stage and throughout implementation. Openness also applies to interacting with surrounding communities. The public can raise its concerns in order to have them addressed in a manner that safety is ensured.

481. Fairness is an important issue for addressing equity issues. The host community will, in effect, be providing a significant service to consumers of nuclear generated electricity and to society at large. In fairness and in recognition, the net befit to the community should be correspondingly significant. Benefits are negotiated with the community to enhance the betterment of the community. Net benefit is intended to achieve fairness, and not to induce the community to accept a facility that is unsafe or environmentally unsound.

482. There is a need for flexibility and patience on the part of the regulatory authority to allow for choice and effective public involvement in decision making. Management options should be adaptable to a wide range of physical conditions and societal requirements, and to potential changes in criteria, guidelines and standards. A stepwise approach to the siting of nuclear facilities should provide opportunities for assessment and decision making during implementation. An ongoing process would need to be flexible to allow for consideration of changing public priorities and values. An interactive process would allow the involvement of the implementing organization, the potential host communities and the regulatory authority to develop the framework of their working relationship in the decision making process on selecting a site for a nuclear facility.

EVALUATING THE COMMUNICATIONS PROGRAMME

483. It is important to build an evaluation process into your communications plan. Evaluation is the rudder that provides direction to the ship. Evaluation makes it possible to systematically determine to what degree the elements of the programme are working and where to focus and prioritize resources. Without evaluation, the communications programme will be required to make 'best guess' decisions which have very often proven to be ineffective.

484. A distinction should be made between public opinion and publicized opinion. Public opinion can be measured by using statistically reliable research methods. Publicized opinions are the opinions expressed through the mass media. At times, both industry groups and elected officials have confused publicized printed opinion with the public's opinion, an action that leads to ineffective strategies.

485. As part of ongoing evaluation of the communication plan, an analysis of the press coverage can be conducted. If the regulatory authority releases a statement, data can be gathered on: which media (TV, radio, print) report it, whether it was reported accurately, were other points of view expressed in the article, such as from industry or environmental organizations; was the article balanced or biased. Over time it may become evident that certain misunderstandings always appear if certain words are used. If there was misinformation or inaccurate reporting an analysis can help to demonstrate how a message can be altered to ensure the press register the desired message the next time.

486. For the evaluation, the organization should develop performance indicators in parallel with its communications performance objectives. The process of developing performance objectives and indicators has proved to be very helpful in systematically thinking through goals

and objectives. For example, five performance objectives can be established. Under each objective, a series of questions intended to measure success can be developed. The organization directs the questions to the specific audience using an opinion research mechanism. These questions can be used to assign an average score to each performance objective. Examples of performance indicators are shown in Chart 5.

487. Programme evaluation requires collecting statistically representative perception data of the target audience (see Conducting opinion research of audiences). The analysis of the results will point up the areas where the communications programme can be improved.

CHART 5. EXAMPLES OF PERFORMANCE INDICATORS TO MEASURE EFFECTIVENESS AGAINST OBJECTIVES

"The organization will work to increase awareness of its role in providing information on nuclear safety issues"

Question: I'm going to read you a list of groups. For each one, I'd like you to tell me if they provide public information on nuclear safety issues. If you don't know, just say so. The first group is... [ROTATE LIST: Your electric company, the regulatory authority, the Department of Education, the Department of Energy/Science/Industry, etc.]

Question: I'm going to read you the same list of groups. For each one, I'd like you to tell me if you [or your office] has ever received or seen information on nuclear safety from that group. The first group is... [ROTATE LIST: Your electric company, the regulatory authority, the Department of Education, the Department of Energy/Science/Industry, etc.]

"The organization will work to be considered a trustworthy source that provides accurate information on nuclear safety issues"

Question: I'm going to read the same list of groups who provide information on nuclear safety issues. For each one, I'd like you to tell me how accurate you consider their information to be. First... [ROTATE LIST: Your electric company, the regulatory authority, the Department of Education, the Department of Energy/Science/Industry, etc.]. Do you consider information from [INSERT LIST, ROTATE ORDER] to be a very accurate, somewhat accurate, not very accurate, or not at all accurate?

Question: Agree/Disagree: I trust what [INSERT NAME OF ORGANIZATION] says when they communicate with the public about nuclear safety.

"The organization will work to establish a reputation as an effective regulator of nuclear technologies that protects public health and safety"

Question: Thinking about [INSERT NAME OF ORGANIZATION] role as independent regulator of nuclear technologies, would you say they are very effective, somewhat effective, not too effective, or not at all effective in protecting public health and safety?

Question: Agree/Disagree: [INSERT NAME OF ORGANIZATION] does a good job of protecting public health and safety?

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ANNEX A

EXAMPLES OF INTERNET HOME PAGES DEALING WITH NUCLEAR SUBJECTS

COMMUNICATING RADIATION CONCEPTS

Theme	Internet site
Radiation Basic Terms - Glossary:	http://www.sph.umich.edu/group/eih/UMSCHPS/terms.htm#top
What you need to know about radiation By Lauriston S. Taylor	http://www.sph.umich.edu/group/eih/UMSCHPS/1st.htm
Radiation and Life by Eric J. Hall	http://www.uic.com.au/ral.htm
Radiation in everyday life Subject: IAEA Fact Sheet	http://www.iaea.or.at/worldatom/inforesource/facsheets/radlife.html
Living with Radiation	http://ulysses.srv.gc.ca/aecb/docs/ads/canliv.htm
History of Radiation	http://www.sph.umich.edu/~bbusby/hist.htm
Radioactivity in Nature	http://www.sph.umich.edu/group/eih/UMSCHPS/natural.htm
Radiation Effects	http://www.rerf.or.jp/eigo/radefx/toc.htm
Radiation Health Effects Research Resource	http://radefx.bcm.tmc.edu/
Environmental Radioactivity from Natural, Industrial, and Military Sources	http://www.apcatalog.com/
Radiation Safety – 1	http://umabbgm.ab.umd.edu/ehs/RadiationSafety/radsafe.htm
Radiation Safety – 2	http://www.iaea.or.at/worldatom/inforesource/other/radiation/radsafe.html
Nuclear and Radiological Safety	http://www.iaea.or.at/worldatom/publications/nrs/rwm.html
Radiation Safety User's Guide	http://www.rso.upenn.edu/htmls/rsoguide.html
NRPB Radiation at Work Leaflets	http://www.nrpb.org.uk/Raw.htm
Radiation: how harmful?	http://whyfiles.news.wisc.edu/020radiation/index.html
Radiation and Risk	http://www.sph.umich.edu/group/eih/UMSCHPS/risk.htm
Risks of Nuclear Energy	http://www.sph.umich.edu/group/eih/UMSCHPS/np-risk.htm
Radiation and the Nuclear Fuel Cycle	http://www.uic.com.au/nip17.htm

Theme	Internet site
Radiation and Risk: How much radiation do we get?	http://www.sph.umich.edu/group/eih/UMSCHPS/risk.htm
Understanding Radiation Risks: Lessons from Paris	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull372/rosen.html
Radiation in Perspective: Improving Comprehension on Risks	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull372/flakus.html
Center for Risk Perception	http://www.cmu.edu/gifs/cmu-button.gif
Risk Perception and Communication 1	http://cccr9.med.bcm.tmc.edu/subject/risk/percep.htm
Risk Perception and Communication 2	http://www.gsia.cmu.edu/afs/andrew/gsia/workproc/phonebook/directory.html
Hazards and Risk - by resources - Communications	http://life.csu.edu.au/hazards/2Communications.html

UNDERSTANDING RADIATION PROTECTION

Theme	Internet site
How Much Do You Know About Radiation Protection?	http://www.epa.gov/radiation/kidspage/quiz.htm
Radiation Protection Today and Tomorrow	http://www.nea.fr/html/rp/rp.html
Radiological Protection Background information	http://www.nrpb.org.uk/Backinfo.htm
The Linear Hypothesis	http://www.formal.stanford.edu/jmc/progress/linear.htm
Radiological Protection in Industry and Medicine	http://www.nrpb.org.uk/Pgrp.htm#BLOCK9
EPA-Radiation Protection	http://www.epa.gov/oar/tickler/radiation.html
Bibliography of Radiation Protection Guidelines	http://home.acadia.net/cbm/Rad3d.html
Radiation Protection	http://web.wn.net/ricter/web/radpro.html
Kid's Page for EPA's Radiation Protection	http://www.epa.gov/radiation/kidspage/index.html

Theme	Internet site
The Good Uses of Nuclear Energy	http://www.iaea.or.at/worldatom/dgspeeches/dgsp1996n15.html
Index of Radioactive Sealed Sources and Devices	http://www.hsrd.ornl.gov/nrc/ssdr/ssdrindx.htm
Code of Practice	http://www.unn.ac.uk/corporate/code.html
Radioisotopes in Medicine	http://www.uic.com.au/nip26.htm
Nuclear Medicine Links	http://www.largnet.uwo.ca/med_links/links.html
Web Sites of Interest to Nuclear Medicine	http://165.134.33.50/Icon/NucMedSites.html
MIR Nuclear Medicine Network Access Page	http://gamma.wustl.edu/home.html
Endocrine -- Table of Contents	http://192.138.33.222/williams/NucMed/thyroid.htm
Radionuclide Ablation of Thyroid Neoplasms	http://192.138.33.222/williams/NucMed/thy10.htm
Criteria for the release of patients containing radioactive materials	http://www.medphysics.com/regulate/criteria.htm
The Nuclear Pharmacy	http://amanda.uams.edu/other/nuclear/webpage.html
Use of Radioactive Materials and Radiation-Producing Machines in the Healing Arts	http://ehs.ucdavis.edu/hp/rsm/viii_k.html
Radioisotopes in Industry	http://www.uic.com.au/nip27.htm
Working Safely in Gamma Radiography: A Training Manual for Industrial Radiographers	http://www.claitors.com/prf/catelog/052-024-00002-1.html
How are radioactive materials used in Industry?	http://www.acuri.com/gauges.html
Smoke Detectors and Americium	http://www.uic.com.au/nip35.htm
Food Irradiation	http://www.sph.umich.edu/group/eih/UMSCHPS/food.htm
Facts about Food Irradiation	http://www.iaea.or.at/worldatom/inforesource/other/food/facilits.html
Transportation of Radioactive Materials for Medicine and Industry	http://www.em.doe.gov/trans2/medicine.html
Preservation/restoration of art objects and archeological objects using radiation	http://www.dta.cea.fr/WWWCEA/nucleart/fr/nucleart.htm
ARC Nucleart — preservation — restoration of art objects, archeological objects using radiation	http://www-dta.cea.fr/wwwcea/nucleart/uk/arc.htm
ARC Nucleart — restoration	http://www.dta.cea.fr/wwwcea/nucleart/uk/restaure.htm

UNDERSTANDING NUCLEAR REACTORS AND NUCLEAR FUEL CYCLE

Theme	Internet site
Nuclear Power Reactors in operation and under construction at the end of 1995	http://www.iaea.or.at/programmes/a2/tab-1.html
The Global Need for Nuclear Power	http://www.iaea.or.at/worldatom/inforesource/dgspeeches/dgsp1996n14.html
Future nuclear power plants: Harmonizing safety objectives	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull374/kabanov.html
The Global Need for Nuclear Power	http://www.iaea.or.at/worldatom/inforesource/dgspeeches/dgsp1996n14.html
Advanced nuclear power plants: Highlights of global development	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull392/juhn.html
Electricity, health & the environment: Selecting sustainable options	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull381/sessions.html
Nuclear power beyond Chernobyl: A changing international perspective	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull381/nuclear.html
US Department of Energy's Operating Experience Analysis	http://www.tis.eh.doe.gov/web/oeaf
Nuclear Energy is the most certain future source	http://www.formal.stanford.edu/jmc/progress/nuclear-faq.html
Uranium mining in Australia	http://www.science.org.au/nova/002/002comp.htm

UNDERSTANDING GUIDANCE, REGULATION AND SAFETY MANUALS

Theme	Internet site
NRC Preliminary Notification	http://www.nrc.gov/OPA/pn/pn19734.htm
Requirements of General Applicability to Licensing of Radioactive Material	http://www.code.co.com/utah/admin/data/r313019.htm#R313-19-1
Laboratory Classification Table	http://www.orcbs.msu.edu/radiation/radmanual(html)/appendixradclass.html
User's Guide: Radionuclide Carcinogenicity	http://www.epa.gov/radiation/heast/userguid.htm
Environmental Health & Safety Radiation Safety Program	http://www.csupomona.edu/ehs/rsmanual.html
Guide For Safe Handling Of Radioactive Sources - January 1997	http://www.pma.caltech.edu/~derose/labs/safety.html
H&S Manual	http://www.llnl.gov/es_and_h/hsm/llnl_hc.shtml
Radiological Safety Manual	http://www.olemiss.edu/depts/environmental_safety/Radsafe.html

Theme	Internet site
Radiation Safety Manual	http://www.orcbs.msu.edu/radiation/radmanual(html)/radman96toc.html
HS&E's Safety Manual	http://www.ehs.muohio.edu/WC/rso_manual.html
Radiation Safety Manual Part 2	http://www.ehs.muohio.edu/WC/rso_manual_part2.html
Miami University Radiation Safety Manual	http://www.safety.ubc.ca/manual/safeman1.htm#index
Worcester Polytechnic Institute Radiation, Health, and Safeguards Committee (RHSC) - Radiation Regulations	http://www.wpi.edu/Admin/Depts/Safety/RSO/RHSC_RR.html
HKUST Safety Manual Section 10, Radiation	http://www.ust.hk/~websepo/sm97/ch10.htm
Caltech Radiation Safety Training and Reference Manual	http://www.cco.caltech.edu/~safety/trm
Radiation Safety Manual 1	http://www.evms.edu/radsafety/rasaman.html
Radiation Safety Manual 2	http://johnson.bcm.tmc.edu/es/rad_safe_man.html

INFORMATION, EDUCATION AND LINKS

Theme	Internet site
Nuclear Medicine	http://www.rso.upenn.edu/htmls/HUPNuclearMedicine.html
IEER's On-Line Technical Classroom	http://www.ieer.org/ieer/clssroom/index.html
Health Physics Society: Glossary Fact Sheet	http://www2.hps.org/hps/glossary.html
Safety at CERN -- 40. Ionising Radiation	http://atlasinfo.cern.ch/CERN/SafetyGuide/Part3/40.0Ionising.html
Nuclear Sciences, Environmental Tracing (GNS - New Zealand)	http://www.gns.cri.nz/nuclear/industrial/tracing/environ.htm
Nuclear Medicine Teaching File	http://gamma.wustl.edu/division/training.html
JPNM Training Program	http://count51.med.harvard.edu/JPNM/JPNMTrainingProg.html
DOE-STD-1070-94, Guidelines for Evaluation of Nuclear Facility Training Programs	http://www.doe.gov/html/techstds/standard/std1070/std1070.html
Radiological Sciences: Sources of Radiation Exposure Training Systems	http://www.chne.unm.edu/chne/hlthphys/RSSUBJCT.HTM
Dose Limits & ALARA	http://tns.sdsu.edu/~ehs/radsafety/train/partiii.html

Theme	Internet site
Radiation Protection Training Course For Radiation Producing Devices	http://www.geog.umd.edu/DES/rs/tmsgrpd/device.html
Sample of Exam Questions	http://www.nmtcb.org/examquestions.htm
Introduction to Nuclear Medicine	http://www.aloha.net/~peters/nmintro.html
IRPA-9 Refresher Courses on The Web	http://www.tue.nl/sbd/irpa or http://www.irpa.at
Radioactive Materials	http://www.environment-agency.gov.uk/s-enviro/pressures/2-16.html
CNS Education and Communication	http://www.science.mcmaster.ca/cns/www/cns/ecc/cnsecc.html
Training and information, publications and communications	http://www.nrpb.org.uk/Planobj.htm #TRAINING AND INFORMATION
Improving dialogue with the community - How to inform the public about risks	http://cccr9.med.bcm.tmc.edu/subject/risk/percep.htm
A Forum to Exchange Information	http://www.nea.fr.html/nea/pr4.html
Nuclear Fuel Cycle Information System - NFCIS	http://www.iaea.or.at/databases/dbdir/db44.htm
DOE Operating Experience Lessons Learned	http://www.tis.eh.doe.gov/web/oeaf/lessons_learned/lessons_learned.html
Nuclear Information World Wide Web Server	http://nuke.westlab.com
Public involvement in the Nuclear Regulatory Commission's activities	http://www.nrc.gov/NRC/public.html
Video Series on Radiation Safety	http://www.pptnet.com/wlrassoc
Risk, Perception, and Media Issues	http://www.nrpb.org.uk/Arp.htm #Population Protection
Release of Radioactive Materials into the Marketplace	http://www.ratical.com/radiation/BNFL+DOE.html
Public Information about Nuclear Issues	http://www.ntanet.net/publicinfo.html
Communications	http://www.sph.umich.edu/group/eih/UMSCHPS/com.htm
Nuclear Science Teacher Activity	http://www.sph.umich.edu/group/eih/UMSCHPSQ/help.htm
Human Radiation Experiments: Roadmap to the Project: Experiments List	http://raleigh.dis.anl.gov/roadmap/experiments/0491doc
Scientific American: Article	http://www.sciam.com/0196issue/0196williams.html
Safeguards & illicit nuclear trafficking Towards more effective control	http://www.iaea.or.at/worldatom/inforesource/bulletin/bull384/thorsten.html
Women in Nuclear	http://shell.rmi.net/~jgraham/WININ.html
WEN, the Women's Energy Network	http://shell.rmi.net/~jgraham/wen.html

Theme	Internet site
NEA Press communiqués: NEA Analyses Lessons from an Internat	http://www.nea.fr/html/general/press/exercise.htm
FEMA -- Preparedness, Training and Exercises NUREG-0654/FEMA-REP-1, Revision 1, Supplement 2	http://www.fema.gov/pte/rep/pubs.htm
Calendar of Nuclear Accidents	http://www.greenpeace.org/~comms/nukes/chernob/rep02.html
Nuclear and Legislation Link	http://www.eskonsult.se/link.htm
NEA Study on National Legislation.	http://www.nea.fr/html/general/press/nat-leg.html
Atomic Physics Links	http://www-phys.llnl.gov/N_Div/atomic.html
Radiation Research Links	http://www.cjp.com/radres/html/links.htm
Nuclear & Atomic Resources	http://www.scamag.com/links/nuke.html
Reactor status and net power worldwide	http://www.uilondon.org/netpower.html
The Virtual Nuclear Tourist!!! Nuclear Power Plants Around the World-- Nuclear Industry Organizations	http://www.cannon.net/~gonyeau/nuclear/inpo.htm
Links to other WWW sites of Nuclear/Radiochemical Interest	http://www.nts-ltd.demon.co.uk/links.htm
Hotlinks to other sites of interest: Nuclear, Biological, and Chemical Sites	http://www.nbc-med.org/hotlist/nuc.html
Nuclear and Legislation Link	http://www.eskonsult.se/link.htm
The World Wide Web Virtual Library: Nuclear Engineering	http://neutrino.nuc.berkeley.edu/NEadm.html
Radiation and Health Related Sites	http://www.health.gov.au/hfs/arl/linkradn.htm

UNDERSTANDING RADIOACTIVE WASTE

Theme	Internet site
Managing Radioactive Waste	http://www.iaea.or.at/worldatom/inforesource/factsheets/manradwa.html
Nuclear Fuel Cycle and Waste Management (bibliography)	http://www.iaea.or.at/worldatom/publications/nfcwm/one.html
The Environmental and Ethical Basis of Geological Disposal of Long-Lived Radioactive Wastes	http://www.nea.fr/html/rwm/geodisp.html
The Virtual Repository: National Briefs by Phil Richardson	http://ourworld.compuserve.com/homepages/geodev/repos.htm
International Rad Waste	http://www.nuc.berkeley.edu/cnwm/reports/RE94-0011/#Spain

Theme	Internet site
EPA Mixed Waste Team homepage	http://www.epa.gov/radiation/mixed-waste/index.html#general
Radioactive Materials	http://www.dehs.umn.edu/rpdXI/wastesec.html
Radioactive Waste Disposal	http://www.cc.rochester.edu/Admin/EHAS/rswstdsp.htm
Dry Radioactive Waste	http://www.facnet.ucla.edu/radsafety/rso_dry.htm
Proper Segregation and Disposal of Low Level Radioactive Wastes (LLRW) at the University of Michigan	http://www.afton.com/llwforum/othlink.html
Disposal of Low Level Radioactive Wastes (LLRW) at the University of Iowa	http://www.uiowa.edu/~vpr/research/hpo/waste/rw03.htm
About LLW Forum	http://www.umich.edu/~oseh/segreg.html
International Rad Waste	http://www.nuc.berkeley.edu/cnwm/reports/RE94-0011
The Virtual Repository: National Briefs by Phil Richardson	http://ourworld.compuserve.com/homepages/geodev/repos.htm
International Rad Waste	http://www.nuc.berkeley.edu/cnwm/reports/RE94-0011/#Spain
EPA Mixed Waste Team homepage	http://www.epa.gov/radiation/mixed-waste/index.html#general
Radioactive Materials	http://www.dehs.umn.edu/rpdXI/wastesec.html
Radioactive Waste Disposal	http://www.cc.rochester.edu/Admin/EHAS/rswstdsp.htm
Dry Radioactive Waste	http://www.facnet.ucla.edu/radsafety/rso_dry.htm
Proper Segregation and Disposal of Low-Level Radioactive Wastes (LLRW) at the University of Michigan	http://www.afton.com/llwforum/othlink.html
Disposal of Low-Level Radioactive Wastes (LLRW) at the University of Iowa	http://www.uiowa.edu/~vpr/research/hpo/waste/rw03.htm
About LLW Forum	http://www.umich.edu/~oseh/segreg.html
International Radwaste	http://www.nuc.berkeley.edu/cnwm/reports/RE94-0011

UNDERSTANDING TRANSPORT OF RADIOACTIVE MATERIAL

Theme	Internet site
Regulations for the Safe Transport of Radioactive Material	http://www.iaea.or.at/worldatom/publications/newrelease/transindex.html
Advanced Radioactive Material Transportation Workshop	http://www.em.doe.gov/trans/catacobb.html

International Standards on the Transport of Radioactive Material	http://www.epa.gov/EPA-MEETING...95/February/Day-07/pr-172.html
Transportation of Radioactive Materials 1	http://www.nrc.gov/OPA/gmo/tip/tip9730.htm
Analysis of the Regulations for the Transport of Radioactive Materials in the FRG and Application to Uranium Ore Concentrate and UF6. Regulations for the Transport of Radioactive Material in Italy:	http://www.ntp.org.uk/rmt/rmt6_41995.html
International Radioactive Material Transportation Standards;	http://www.epa.gov/EPA-GENERAL/1995/April/Day-11/pr-405.html
Transportation of Radioactive Materials 2	http://www.nuc.umr.edu/~ans/trans.html
Transportation of Radioactive Materials for Medicine and Industry	http://www.em.doe.gov/trans2/medicine.html
Transport of Radioactive Material.	http://www.ntp.org.uk/rmt/rmt7_41996.html
Course on Transportation and Packaging of Radioactive Materials	http://www.ntanet.net/nta/transport.html
Transport of Radioactive Material Training Manual	http://www.ne.orst.edu/~doddb/iaea.html
Radioactive Material Transportation Training for Drivers and Handlers	http://www.em.doe.gov/trans/catacoff.html
IRPA9 Refresher Course Table of Contents Transport of Radioactive Material	http://www.tue.nl/sbd/irpa/irpa9toc.htm
Plutonium Air Shipments	http://www.nci.org/nci/airtrans.htm

UNDERSTANDING EMERGENCY

Theme	Internet site
Training in Radiation Emergencies for Emergency Services Professionals	http://www.nrpb.org.uk/Pr5-97.htm
Nuclear and Radiological Safety Accident Response	http://www.iaea.or.at/worldatom/publications/nrs/ar.html
The IAEA emergency response system	http://www.iaea.or.at/worldatom/inforesource/factsheets/emergency.html
Disaster Preparedness for Radiation Accidents	http://cccr9.med.bcm.tmc.edu/subject/needs/dp.htm
Reactor accidents	http://www.sph.umich.edu/~bbusby/np-risk.htm
Subject: Ten Years after Chernobyl: What do we really know?	http://www.iaea.or.at/worldatom/inforesource/other/chernoten/index.html
317 Bulletin Vol.38/3 Chernobyl - Ten years after	http://www.iaea.or.at/worldato...bulletin/bull383/gonzalez.html
Managing a nuclear weapons accident	http://www.nmt.edu/~ahicks/nuke.html
Accident Investigation	http://www.aomc.org/HOD2/general/Accinjpr-ACCIDENT-3.html

Three Gammagraphy Incidents in Spain (Cases no 5a, 5b, 5c)	http://www.cepn.asso.fr/english/EAN/EAN-42.html
Incident with radiography in Sweden (Case no 6)	http://www.cepn.asso.fr/english/EAN/EAN-43.html
A plan for protecting the population in the event of a radiological accident or incident.	http://www.ci.baytown.tx.us/dept/emer/defense.html

WHAT PUBLIC ASK AND NUCLEAR COMMUNICATORS SHOULD TRAIN HOW TO ANSWER

Theme	Internet site
FAQ's About Radiation Exposure	http://radiant.uchicago.edu/uofcinfo/faqabo~1/faq.htm
FAQ's About Radiation Exposure	http://www.sph.umich.edu/~bbusby/qanda.htm
FAQ's on Radiation	http://www.nsc.org/ehc/WIPP/wipp_rad.htm
FAQ's about nuclear energy	http://www.ncf.carleton.ca./~cz725/
FAQ's About Nuclear Energy	http://www-formal.stanford.edu/jmc/progress/nuclear-faq.html
FAQ's Radon Mitigation	http://www.infiltec.com/inf-faqr.htm
FAQ's about Radon	http://doityourself.com/home/radon.htm
FAQ's about Radon	http://www.physics.csbsju.edu/MNradon/faq.html
FAQ's Nuclear Medicine	http://www.bih.harvard.edu/rad.../Modalities/Nucmed/nucfaq.html
FAQ's Nuclear Medicine	http://tribune.bih.harvard.edu.../Modalities/Nucmed/nucfaq.html
FAQ's How does radioactive iodine work?	http://houston-interweb.com/thyroid/faq/23.html
FAQ's transport	http://www.nsc.org/ehc/WIPP_tra.htm
FAQ's Packaging	http://www.et.anl.gov.faq.htm
Mixed Waste Frequently Asked Question	http://www.epa.gov/radiation/mixed-waste/mw_pg17.htm
Answers to Your Nuclear Science Question	http://www.cannon.net/~gonyeau/nuclear/answers.htm
FAQ's regarding nuclear power generation in Canada	http://www.ncf.carleton.ca/~cz725/
FAQ's about nuclear power	http://www.tvo.fi/efaq.htm
FAQ's nuclear general subjects	http://hawkeye.me.utexas.edu/~ans

Theme	Internet site
FAQ's nuclear general subjects	http://nova.nuc.umr.edu/~ans/QA.html
FAQ's in Plasma Physics and Fusion Energy	http://www.pppl.gov/~rfheeter/
FAQ's Fusion Princeton Grad. Programme American Nuclear Society	http://www.princeton.edu/~tcarter/fusion.html
FAQ's High Energy Nuclear Science Group	http://rhic.physics.wayne.edu/faq.html
FAQ's The Nuclear accident at Chernobyl	http://www-formal.stanford.edu/jmc/progress/chernobyl.html
FAQ's Ukraine + The Ukrainian Weekly Chornobyl The First Decade Issue	http://www.tryzub.com/UFPWWW_E...y/Chornobyl960505/Address.html
FAQ's about the Atomic Bomb Survivor Research Program	http://www.rerf.or.jp/eigo/faqs/faqse.htm
FAQ's about Nuclear Weapons	http://astro.uchicago.edu/home/web/jeffb/abomb/nfaq0.html
FAQ's Nuclear Weapons Organization	http://www.warewulf.com/nuke/Nwfaq/Nfaqorg.html
FAQ's Anti-nuclear arguments	http://steam.stanford.edu/jmc/progress/anti-nuke.html
FAQ's Anti-nuclear arguments	http://www-formal.stanford.edu/jmc/progress/anti-nuke.html
FAQ's Nuclear Safety Culture	http://www.technidigm.org/Technuke/nuclear.htm
FAQ's on Nuclear Energy Politics	http://steam.stanford.edu/jmc/progress/nuclear-politics.html
Questions and Answers about Nuclear Energy	http://www.nuc.umr.edu/~ans/QA.html
The Canadian Nuclear FAQ	http://www.ncf.carleton.ca/~cz725
NRPB FAQS – RADON	http://www.nrpb.org.uk/Qradon.htm
Perguntas e respostas	http://www.ipen.br/scs/peresp.
NRPB FAQS	http://www.nrpb.org.uk/Faqs.htm
Questions and Answers 1	http://www.sph.umich.edu/~bbusby/qanda.htm
Questions and Answers 2	http://radiant.uchicago.edu/uofcinfo/faqabo~1/faq.htm
Questions and Answers 3	http://radiant.uchicago...fcinfo/faqabo~1/faq.htm
The American Nuclear Society [ANSWER]	http://www.ans.org
Questions and Answers about Nuclear Energy	http://www.nuc.umr.edu/~ans/QA.html

Theme	Internet site
Question on nuclear science, power generation, regulation, or safety	http://www.cannon.net/~gonyeau/nuclear/answers.htm

CONTROVERSIAL AND OPPOSITION TO NUCLEAR

Theme	Internet site
Frontline Nuclear Reaction - Why do Americans Fear Nuclear Power?	http://www.pbs.org/wgbh/pages/frontline/shows/reaction http://www.pbs.org/wgbh/pages/frontline/shows/reaction/interact/facts.html
NukeNet Anti-Nuclear Network	http://www.envirolink.org/orgs/nukenet/index.html
Environmentalists against nuclear industry legislation	http://www.alphacdc.com/ien/no-s104.html
Anti-nuclear arguments: - Spent Nuclear Fuel Transport - The Risks	http://www.sofcom.com.au/greenpeace/spentrod.html
Nuclear Waste in Sweden - The Problem Is Not Solved!	http://www.folkkampanjen.se/nwfront.html
The Swedish Anti-nuclear Movement	http://www.folkkampanjen.se/engfront.html
France's Stubborn Atomic Murder (article is based on press releases on the Greenpeace World Wide Web site)	http://www.imaja.com/imaja/change/sept95/atomicmurder.html
The Nuclear Age Peace Foundation's	http://www.wagingpeace.org/web-structure.html

ANNEX B

EXAMPLES OF WRITTEN COMMUNICATION

IAEA
10 October 1997
PR 97/29

Joint Convention on the Safety of Spent Fuel Management
and on the Safety of Radioactive Waste Management

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the first legal instrument to directly address these issues on a global scale, was opened for signature on 29 September 1997, the first day of the 41st regular session of the IAEA's General Conference. As of one week following opening for signature, i.e. 6 October 1997, 23 States have signed the Joint Convention.

These States were: Czech Republic, Finland, France, Germany, Hungary, Indonesia, Ireland, Luxembourg, Morocco, Norway, Kazakstan, Republic of Korea, Lebanon, Lithuania, Poland, Romania, Slovakia, Slovenia, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America.

The Joint Convention applies to spent fuel and radioactive waste resulting from civilian nuclear reactors and applications and to spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes, or when declared as spent fuel or radioactive waste for the purpose of the Convention by the Contracting Party. The Convention also applies to planned and controlled releases into the environment of liquid or gaseous radioactive materials from regulated nuclear facilities.

The obligations of the Contracting Parties with respect to the safety of spent fuel and radioactive waste management are based to a large extent on the principles contained in the IAEA Safety Fundamentals publication "The Principles of Radioactive Waste Management". They include, in particular, the obligation to establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management and the obligation to ensure that individuals, society and the environment are adequately protected against radiological and other hazards, inter alia, by appropriate siting, design and construction of facilities and by making provisions for ensuring the safety of facilities both during their operation and after their closure. The Convention imposes obligations on Contracting Parties in relation to the transboundary movement of spent fuel and radioactive waste based on the concepts contained in the IAEA Code of Practice on the International Transboundary Movement of Radioactive Waste. Also, Contracting Parties have the obligation to take appropriate steps to ensure that disused sealed sources are managed safely.

The Convention will enter into force on the ninetieth day after the twenty-fifth instrument of ratification is deposited with the IAEA, including the instruments of fifteen States that each have an operational nuclear power plant.

IAEA
4 December 1997
PR 97/39

INTERNATIONAL ATOMIC ENERGY AGENCY INSPECTION WORK IN IRAQ

Director General Mohamed Elbaradei of the International Atomic Energy Agency (IAEA) today informed the Secretary General of the United Nations, Mr. Kofi Annan, that in the nuclear field it is highly unlikely that any proscribed activities occurred and that no relevant materials or equipment were diverted during the 23 day period of absence of IAEA inspectors from Iraq (October 29 to November 20).

Since returning to Iraq on November 21, IAEA inspectors have carried out more than 40 inspections to restore the technical basis for the IAEA's ongoing monitoring and verification activities in Iraq.

The Director General also informed Mr. Annan that an IAEA team intends to visit Iraq in the week of December 15 to clarify a number of outstanding matters mentioned in the Agency's last report to the Security Council.

The Agency believes resolution of these matters would provide further assurance that its technically coherent picture of Iraq's clandestine nuclear programme is comprehensive and that there are no activities outside this picture. It would also permit the IAEA to tailor its ongoing monitoring and verification activities appropriately.

ANNEX C

RESPONDING TO QUESTIONS FROM A JOURNALIST

THREE RULES APPLY

- Never lie or mislead a reporter.
- Never speculate or comment upon matters outside your area of competence.
- Always be cool and professional even in the face of hostile and emotional questions.

THE WARNING SIGNS OF DEADLY QUESTIONS

1. **THE QUOTE** – Your antennae should go up quickly whenever you hear a reporter ask a question that begins with some variation of: "Are you trying to say...?" "Do you mean...?" "Are you telling me that...?" These are quote questions, and this is how reporters write those quotes that you never said.

Response: Be very specific and do not allow a reporter to put words in your mouth. If a reporter is reporting what you want to say. Fine. Say so. And make sure they get it right. Otherwise, say "NO" immediately and pointedly. You can handle this politely by responding. "NO". "What I mean, and you can use this as a direct quote, is...."

2. **THE DEBATE** – Recognize that a reporter is trying to debate you when a question begins with a variation of: "Some people say...." "Critics think..." "According to..." Generally, a reporter asks this question for one of two reasons: the reporter believes the charge makes sense or has merit. And honestly wants your rationale, position or opinion: or, the reporter is purposely baiting you, and is trying to get you upset or angry.

Response: First, learn to recognize when a reporter is honestly seeking information, or trying to bait you. In the case of the former, realize you are talking directly to the reporter, and use the challenge as an opportunity to educate. If it is the latter instance, do not answer the question. Instead, challenge the reporter's source. "What critics".

3. **THE LAUNDRY LIST** – Do not get confused by the "laundry list" which consists of a series of statements or questions asked at the same time by a reporter. For example: "Are you going to strike? If so, when? Don't you know strikes are illegal?" or "Is the operator incompetent or deliberately misleading the public?".

Response: Do not panic, and do not try to deal with all points or questions. If necessary, ask the reporter to repeat the laundry list. He or she may rephrase the question in a way to make it easier to answer, or you may get an opportunity to stall in order to frame a response. Pick a single point in the laundry list and focus your answer on that particular aspect.

4. **THE ASSUMPTION** – Often, reporters will state an opinion or value judgement as a self-evident fact, and then ask a question based on that "fact". For example "We all know nuclear plants are dangerous. How can you justify saying there is no risk to the public?" "It's your job to keep the public calm and play down the gravity of an accident. How much faith can we have in your assessment?"

Response: Whenever a reporter makes a biased claim and asks questions based on that assumption, do not answer the question. Under these circumstances, the reporter is controlling the interview and is forcing you into a defensive position. Always direct your answer at the assumption not the question. Using the above example, an appropriate response might be: "Nuclear plants are not more dangerous than other industrial facilities and have more safety features and regulations to ensure this than any others". " It is our job to see that safety regulations are adhered to, but if something goes wrong we make an objective assessment of what steps to take including protection of the population if necessary".

5. **THE TRAP** – Reporters particularly enjoy asking trap questions also known as "when did you stop beating your wife?" questions. In other words, by answering the trap question you give credibility to the charge or premise that the question is based on. Here's one "When will you have to order evacuation?" Until this point in the interview, you may have avoided the evacuation topic, or even denied the possibility of such action. Now, a reporter has you analyzing the possible need for a major decision that may never need to be addressed in the first place.

Trap questions can be dangerous, and reporters look for ways to turn your words against you in developing questions to ask. Doing this is part of a good reporter's job, so don't be offended. At the same time, don't allow the trap question to make you look foolish.

Response: The best defence against the trap is to recognize it. The trap question is a reporter's technique for controlling an interview, and for getting into issues that interest the reporter. Remember your techniques for controlling the interview, and use them. Make the trap question lead into the points that you want to emphasize. Using the above example, a response might be: "Whoever said evacuation is a logical step in this situation? Such speculation is totally premature and irresponsible. The information we have is that everything is under control and the necessary remedial action is in hand".

ANNEX D

EXAMPLES OF COMMUNICATION PROGRAMMES

COMMUNICATION DURING THE RADIOLOGICAL ACCIDENT IN GOIANIA

Following is a short summary of the communication programme pursued by the Brazilian Nuclear Energy Commission (CNEN) during the mitigation of the consequences of the radiological accident in Goiânia, Brazil, 1987 [11].

Why was communication needed in Goiânia?	• To reduce the psychological impact in Goiânia due to conflicting information. • To assist any individual through dialogue using all available channels of communication. • To make the population aware that we are telling them the truth. • To disseminate correct information. • To convince decision makers of the urgent need of logistic support.
What steps did the regulatory authority and the State take in terms of communication to gain credibility of population in Goiânia?	• They met with key personnel of the city and surrounding areas (social associations, victims, schools, press, Congress, etc.) • They visited families living close to the main foci of contamination to explain what was happening. Special meetings were held with groups of mothers. • They edited a brochure explaining the special terms and units related to radiation. • They met with the press twice a day to explain developments in the situation. • They responded to any question or concern of the population.
Where did the CNEN spokespersons in Goiânia go to carry out the communication programme ?	• Wherever the public was alarmed. • Wherever antagonism was present. • Wherever they were invited to discuss the accident and measures, be it within Goiânia or outside of the city or State.
When did CNEN in Goiânia start with the communication (information) system?	• Upon arrival in the city and continuously up to the present.
How could CNEN do it?	• By responding immediately to any question • By understanding the root causes of the accident. • By understanding human factors. • By having operational experience in radiation matters. • By using simple language. • Because of its knowledge of legislation and regulation. • Because of its good and frequent interaction with all organizations involved in the mitigation of the consequences of the accident.

SWISS COMMUNICATION PROGRAMME ON RADON

Measurements performed in the early 1980s revealed very high indoor radon concentrations. A research programme was then initiated and co-ordinated by the Federal Office of Public Health (FOPH). The results were published in 1992[1] and indicated a real need for communication with the following main target groups:

- Local authorities
- Population in areas with high indoor radon concentrations
- Construction experts
- General population.

It was then decided to implement regulations on radon in the ordinance on radiological protection. The main aims were to avoid elevated concentrations for new constructions, take protective measures (for instance for tenants) and establish remedial programmes.

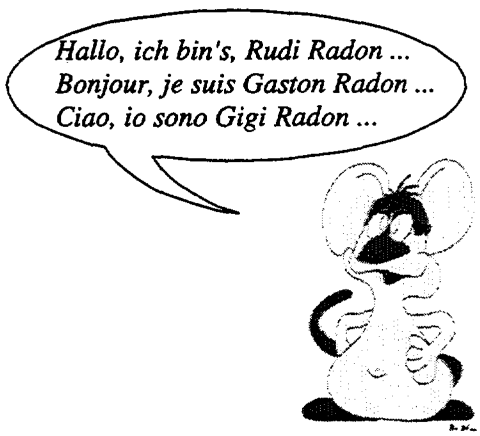
Action	Target group
Determination of radon areas	
– Protocol for measurement	Local authorities, recognized measuring laboratories
– Information on radon	General population
– Measurement	Local authorities, recognized measuring laboratories
– Communication of results	House owners, tenants
– Classification & mapping	Local authorities, house owners, construction experts
– Publication	General public, mass media
Preventive measures	
– Building regulations	Local authorities
– Information on possible measures	Local authorities, construction experts, house owners
Remedial programmes	
– Elaboration	Local authorities
– Information on possible measures	Local authorities, construction experts, house owners

The contact with local authorities and mass media showed that the information has to be presented in an objective and transparent way. The radon problem has not to be overstated,

1 Radonprogramm Schweiz "RAPROS", Bericht über die Jahre 1987-1991, Abteilung Strahlenschutz, Bundesamt für Gesundheit, CH-3003 Bern, ISBN 3-905235-00-5.

but not played down either. For its presentation different information material is available in German, French and Italian.

Oral presentations	– Set of 30 transparencies – Set of 50 slides – Photo-CD – Multimedia-CD-ROM with Mr. Radon
Exhibitions	– Set of 16 Posters – Accompanying leaflet
Documentation	– Leaflet for all audience members – Leaflet on construction measures – Yearly radon report



Every year a selective action is carried out. In 1997, for instance, all Swiss architects got four successive mailings every two months. This way, the information density was not too high and the durability of the radon knowledge could be increased. These actions have to be evaluated in order to investigate the achieved effect and to take corrective measures if necessary.

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IAEA SAFETY RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish standards of safety for protection against ionizing radiation and to provide for the application of these standards to peaceful nuclear activities.

The regulatory related publications by means of which the IAEA establishes safety standards and measures are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety, and also general safety (that is, of relevance in two or more of the four areas), and the categories within it are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides.**

- **Safety Fundamentals** (silver lettering) present basic objectives, concepts and principles of safety and protection in the development and application of atomic energy for peaceful purposes.
- **Safety Requirements** (red lettering) establish the requirements that must be met to ensure safety. These requirements, which are expressed as 'shall' statements, are governed by the objectives and principles presented in the Safety Fundamentals.
- **Safety Guides** (green lettering) recommend actions, conditions or procedures for meeting safety requirements. Recommendations in Safety Guides are expressed as 'should' statements, with the implication that it is necessary to take the measures recommended or equivalent alternative measures to comply with the requirements.

The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA for application in relation to its own operations and to operations assisted by the IAEA.

OTHER SAFETY RELATED PUBLICATIONS

Under the terms of Articles III and VIII.C of its Statute, the IAEA makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its members for this purpose.

Reports on safety and protection in nuclear activities are issued in other series, in particular the **IAEA Safety Reports Series**, as informational publications. Safety Reports may describe good practices and give practical examples and detailed methods that can be used to meet safety requirements. They do not establish requirements or make recommendations.

Other IAEA series that include safety related sales publications are the **Technical Reports Series,** the **Radiological Assessment Reports Series** and the **INSAG Series**. The IAEA also issues reports on radiological accidents and other special sales publications. Unpriced safety related publications are issued in the **TECDOC Series**, the **Provisional Safety Standards Series**, the **Training Course Series,** the **IAEA Services Series** and the **Computer Manual Series**, and as **Practical Radiation Safety and Protection Manuals**.