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STUDY GUIDE

IAEA

International Atomic Energy Agency

"Strengthening Global Security and Preparedness for Nuclear Disasters"

Letter from the Executive Board

Greetings Delegates,

We welcome you all to the simulation of the International Atomic Energy Association (IAEA) at VITCMUN 2017**.** It is a distinct privilege and honor to be able to preside over this committee, and we hope the debate and discussion that takes place in the three days of council will serve to inspire you, and provoke you to action. Often, we are too occupied with the fast paced political and military action that occupies the forefront of our everyday discourse, to notice the smaller cogs that keep turning to ensure stability and security. One such cog lies in the highly important work of the IAEA. Perhaps it seems rather dull, rather unexciting, to focus on promoting peaceful use of nuclear energy, to research, to learn, to provide safeguards. But, at the end of the day, the remarkable cooperative efforts championed by representatives of member states of the IAEA keeps a power as potent as nuclear energy in a safe and secure framework meant to ensure the propagation of its use, while curtailing the possibility of misuse.

Take the time to thoroughly read this background guide, but spend sufficient time looking at relevant resources and materials, to get truly in-depth knowledge of the issues surrounding this agenda. This background guide is merely intended to provide you with basic information about certain aspects of the IAEA and its work that will enable you to take your research in the direction you wish it to go. We strongly encourage looking through the resources provided to jumpstart your work if you feel overwhelmed- but at no point should this guide be taken as the be all end all in your research for this council. If you have any queries, or need any help, please do feel free to contact us- we will always be ready to help.

Best of Luck!

Regards,

Priya Subramanian	Pradeep Vasu	Adeeb Ahmed
Chairperson	Vice Chairperson	Director

Overview of Council

The International Atomic Energy Association was formed on July 29, 1957, as an autonomous body. The IAEA established its own charter, but reports to the United Nations General Assembly and the United Nations Security Council. The IAEA was established at a time when the very real danger of nuclear material and the technology to access nuclear power being in the wrong hands, or being used for the wrong purposes, became extremely clear. In U.S. President Dwight D. Eisenhower's Atoms for Peace address to the United Nations General Assembly, the original idea for an international body to regulate and promote the peaceful use of nuclear power was put forth. More radically, the United States would propose the idea of an international body that would, in addition to the above, also take control of fissile material, and function almost as a nuclear bank. By 1954, it became abundantly clear that the Soviet Union would not take kindly to any such attempts, and it became imperative to find a middle ground for the proposed organization to act upon.

In August 1955, the International Conference on the Peaceful Uses of Atomic Energy was held by the United Nations in Geneva, Switzerland, . The Statute was discussed and negotiated by twelve countries, and was approved in October 1956, finally entering into force and establishing the IAEA on the 29th of July, 1957.

The IAEA is an intergovernmental forum for scientific and technical cooperation in the peaceful use of nuclear technology across the world. It serves as a platform to encourage development of peaceful technologies, providing safeguards, promote safety, and aid in implementation of safety standards. The IAEA's mission is supported by three pillars: Safety and Security; Science and Technology; Safeguards and Verification. These, along with the specific needs and interests of member states and the goals put forth in the IAEA Statute, guide the overall mission and work of the organization.

There are three main bodies in the IAEA: the Board of Governors, the General Conference, and the Secretariat. The Board of Governors is a policy making body of the IAEA, which consists of 22 elected members, and at least 10 nominated members. It makes recommendations for the IAEA's budget and activities, policy plans, publishing IAEA standards, and nominating the Director General subject to the General Conference's approval. The General Conference consists of all 168 member states, and meets once a year to deliberate and pass the decisions taken by the Board of Governors. The Secretariat is the professional and general service staff of the IAEA, and is headed by the Director General (currently Yukiya Amano). The Director General oversees six departments that carry out the functions of the IAEA: Nuclear Energy, Nuclear Safety and Security, Nuclear Sciences and Applications, Safeguards, Technical Cooperation, and Management.

Introduction to Agenda

We live in an age where access to nuclear power for either peaceful, or not so peaceful purposes, has become a standard that many countries clamor to achieve, rather than a carefully used tool that only those who are trusted to harness it appropriately are able to access. It thus becomes extremely important to understand the implications of widespread use of nuclear power, especially with concurrently rising instability and rapidly evolving technologies. Many of these technologies are aimed at furthering the use of nuclear power as a civilian power source-providing energy in a more efficient way than ever before. However, even the most innocuous technology, when corrupted, can prove deadly. Safeguards must advance rapidly as the base technologies, or we face a world where we have power, but not the ability to contain its deadly force should it go out of our hands.

In order to understand the process that is to be undertaken in strengthening global security measures, one must understand several other basic issues. Primarily, these are how responses to past nuclear crises have impacted discourse on the issue, the safeguards and security measures we have in place, and the ways in which nuclear power is used in a peaceful and productive manner. The IAEA words towards creating protocols to aid in mitigation of damage caused by nuclear disaster. However, the IAEA's work as an entity is not sufficient. The requirement for global involvement is a particular one, and one that is vital in that it ensures that IAEA members are each prepared to handle any nuclear disaster that occurs. Past disasters have given us a taste of the massive work it takes to contain and neutralize a nuclear crisis. Future disasters promise to be much greater in magnitude, and certainly far more difficult to contain.

In the course of this debate, it is important that past disasters, current power plants, weapons stockpiles, technologies, agreements, and security measures are all thoroughly investigated and understood, and that an understanding of improvements for the future is garnered.

Nuclear Safety: Discourse and Technology in Use

According to the IAEA, **nuclear safety** is "The achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards[1]"

Over the years, multiple safety regulations and measures to prevent nuclear disasters have been proposed. The IAEA Convention on Nuclear Safety (CNS) was formulated during multiple expert level meetings from 1992 to 1994 and was the result of considerable work by national nuclear safety authorities, the governments and the IAEA Secretariat. Its aim is to legally commit participating States operating land-based nuclear power plants to ensure a high level of safety by setting international benchmarks to which all states would rigidly subscribe.

The Convention entered into force in October 1996. As of September 2009, there were 79 signatories to the Convention of which 66 members are contracting parties, including all states with nuclear power plants that are operational.

The obligations of the Parties are based to a large extent on the principles contained in the IAEA Safety Fundamentals document "Fundamental Safety Principles (SF-1)". These obligations cover for instance, siting, design, construction, operation, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness.

The Convention is based on Parties' common interest to achieve higher levels of safety which will be developed and promoted through regular meetings. The Convention obliges Parties to submit reports on the implementation of their obligations for "peer review" at meetings of the Parties to be held at the IAEA. This mechanism is the main innovative and dynamic element of the Convention.

[1] http://www-ns.iaea.org/standards/concepts-terms.asp

IAEA Design Safety Reviews and Generic Reactor Safety Reviews:

An IAEA Design Safety Review (DSR) is performed when a member state organization requests to evaluate the completeness and comprehensiveness of a reactor's safety documentation by a team of international experts. It is based on IAEA published safety requirements and standards.[2] If the DSR is for a vendor's design at the pre-licensing stage, it is done using the Generic Reactor Safety Review (GRSR) module. IAEA Safety Standards applied in the DSR and GRSR at the fundamental and requirements level, are generic and apply to all nuclear installations. Therefore, it is neither intended nor possible to cover or substitute licensing activity, or to constitute any kind of design certification.

DSRs have been undertaken in Pakistan, Ukraine, Bulgaria and Armenia. GRSRs have been done on AP1000 (USA & UK), Atmea1, APR1400, ACPR-1000+, ACP1000, and AES-2006 and VVER-TOI[3]**.**

Applications of Nuclear Technology

Non-power nuclear applications, although often overlooked, have expanded to become a nearly constant factor in daily life — such as in the radiation techniques used to sterilize medical supplies, or to toughen the rubber in automobile tires. In recent years, the IAEA´s focus has increasingly been drawn to using nuclear and isotopic techniques to address daunting challenges in the developing world — hunger, disease, poverty and a shortage of drinking water.

One classic example to consider would be the application of the radiation induced "sterile insect technique" (or SIT) to control insect pests. The tsetse fly has long devastated sub-Saharan economies by killing livestock — including draft animals used in farming — and by spreading deadly sleeping sickness to humans. In 1997, SIT was successfully used to eliminate the tsetse fly from Zanzibar, where other techniques, including the massive application of pesticides, had failed. Long term projects are now underway to use SIT, with full government commitment, and

[2] http://www-ns.iaea.org/conventions/nuclear-safety.asp

[3] http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/safety-of-nuclear-power-reactors.aspx

in conjunction with other non-nuclear techniques, to eliminate the tsetse from other parts of Africa. And the same SIT technique has been used to eradicate the screwworm and the Mediterranean fruit fly (or medfly) from other countries and entire regions.

Perhaps an even greater socio-economic benefit has resulted from radiation induced mutation in crops. For example, the development of new rice strains has resulted throughout Asia in tens of billions of dollars of increased crop value at the farm gate[4]

[4]https://www.iaea.org/newscenter/statements/peaceful-uses-nuclear-energy-meeting-societal-needs

Overview of Security Mechanisms Currently in Use

This covers nuclear power plants and all other nuclear facilities, the transportation of nuclear materials, and the use and storage of nuclear materials for medical, power, industry, and military uses.

Let's look back at the incident at Fukushima in Japan, where nuclear reactors were affected by the earthquake. The designers failed to realize the fact that the backup generators would fail in the case of such a big natural disaster. This means that Japan had to deal with two big disasters at once, an earthquake and the nuclear leak. This left much of the world wondering whether even such an advanced country like Japan can handle nuclear energy.

The fundamental responsibility of the nuclear power plant operation worldwide is that the operator is responsible for the safety. The national regulator is responsible for ensuring the plants are operated safely by the licensee, and that the design is approved. A second important concept is that a regulator's mission is to protect people and the environment. It has long been asserted that nuclear disasters are the epitome of low probability but high consequential risks. This may be the widely accepted fact about the use of nuclear energy. That it is in fact a very risky way of obtaining energy but if it were done in a safe way, it could be more of a boon than bane. Bearing that in mind, we cannot ignore the fact that an accident caused by a nuclear source is way more severe than that caused by a majority of other industrial and energy sources.

To achieve optimum safety, nuclear plants operate with a 'defense in depth' approach which contains multi-layered systems supplementing the natural features of the reactor core. Key aspects being:

1. High-quality design & construction
2. Equipment which prevents operational disturbances or human failures and errors developing into problems
3. Comprehensive monitoring and regular testing to detect equipment or operator failures,
4. Redundant and diverse systems to control damage to the fuel and prevent significant radioactive releases
5. Provision to confine the effects of severe fuel damage (or any other problem) to the plant itself. [5]

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[5]http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/safety-of-nuclear-power-

These can be summed up as: Prevention, Monitoring, and Action (to mitigate consequences of failures).

The first level of defense is to prevent deviations from normal operations for whatever reason it may be and the failure of items important to safety. This leads to requirements that the plant be soundly and conservatively sited, designed, constructed, maintained and operated in accordance with quality management and appropriate and proven engineering practices. Design variations are mostly made at this level of defense so that it can improve the security and safety of a nuclear core. Attention is paid to the processes and procedures involved in the design and any minute adjustments are made at this level and are then incorporated into the whole design later on. A second level of defense is then incorporated to detect and control deviations from normal operational states in order to prevent anticipated operational occurrences at the plant from escalating to accident conditions. This second level deems whether the variation designs in the safety system is effective enough through safety analysis and the establishment of operating procedures to prevent such initiating events. The third level of defense, in case of a nuclear accident, is set up in the event of escalation of certain anticipated operational occurrences or postulated initial events. The purpose of the fourth level of defense is to mitigate the consequences of accidents that result from failure of the third level of defense in depth. This is achieved by concentrating the accident in one particular area and mitigating in case of severe accidents. Off site contamination should be minimized or avoided. The fifth and final defense that is set in place is to mitigate the radiological consequences of radioactive releases that could potentially result from major accidents. This requires the provision of adequately equipped emergency response facilities and emergency plans and emergency procedures for on-site and off-site emergency response.

The safety provisions include a number of physical barriers between the radioactive core and the environment, each of these barriers with backup and designed to accommodate human error. Safety systems account for one quarter of the capital cost of the nuclear reactors. But considering the severity of damage that a nuclear leak can cause, is this really enough?

Nuclear plant performance is usually monitored in terms of three strategic areas: reactor safety, radiation safety and nuclear plant security. Highly trained inspectors are always on site at each

reactors.aspx

plant to provide oversight of plant operations, maintenance, equipment replacement and training. A breach in any one of these above three factors may lead to an alert in the nuclear plant's alarm. The fact of the matter though, is that nuclear plants emit negligible amounts of radiation but in due course, this will affect a person. The NRC(Nuclear Regulatory Commission sets limits to the amount of radiation that workers can be exposed to, annually but is that really something than can be weighed on a scale?

The IAEA has also had the following objectives in mind, with national acceptance criteria:

(a) To prevent accidents with harmful consequences resulting from a loss of control over the reactor core or over other sources of radiation, and to mitigate the consequences of any accidents that do occur;

(b) To ensure that for all accidents taken into account in the design of the installation, any radiological consequences would be below the relevant limits and would be kept as low as reasonably achievable;

(c) To ensure that the likelihood of occurrence of an accident with serious radiological consequences is extremely low and that the radiological consequences of such an accident would be mitigated to the fullest extent practicable.

To demonstrate that the fundamental safety objective is achieved, a safety assessment review of the whole design is carried out. This review is done to assess all sources of radiation and to evaluate how much radiation can be could be received by the workers or the general public that might be exposed to it, as well as the environmental effects. On the basis of this analysis, the capability of the design to withstand postulated initiating events and accidents can be established.

Past nuclear disasters and responses

To understand what exactly has been done up till now about the mitigation of nuclear accidents and prevention of their increment, we'll have to see how two major disasters were dealt with, mainly the Three Mile Island incident and Fukushima incident.

The Three Mile incident of 1979 demonstrated the importance of pre-existing safety measures. Despite the fact that about half the reactor core melted, radionuclides released from the melted fuel mostly plated out on the inside of the nuclear plant or dissolved in the condensing steam. This made sure that not much of the radioactivity got out into the open atmosphere. The containment building which housed the reactor further enhanced the fat that this prevented significant radioactive release. The accident was attributed to mechanical failure and operator ‘confusion.’ The reactor’s other protection systems functioned as designed, though. The emergency cooling systems of the reactor would have prevented any further significant damage to the reactor but for the intervention of the operators. Consequently, investigations following the accidents led to a new focus that wasn’t considered before, the human factors involved in nuclear safety. This in fact had a significant change forthwith. No major design changes were introduced in the western reactors, but controls and instrumentation were improved significantly and operator training was overhauled and improved.

Now let’s consider the Fukushima Daiichi incident of March 11 when THREE operating reactors shut down automatically which were then being cooled down as designed by the normal residue heat removal systems which were drawing power from the back-up generators. These generators were in turn swamped by the tsunami. This also led to the emergency cooling systems to fail. A while later, the spent fuel ponds lost water. This was a separate problem but equally severe. Analysis later showed the need for more intelligent siting criteria than the ‘pre-historic’ ones that were inculcated since the 1960s, and the need for better backup and post shutdown cooling. This also called for the provision for venting the containment of that kind of reactor and other emergency management procedures. Nuclear plants are always supposed to be equipped with Severe Accident Mitigation Guidelines (SAMG or in Japan: SAG) and most of these, address what should be done for accident beyond design basis and where several systems may be disabled. The severe underperforming of the nuclear shutdown facilities in Japan is exactly what this committee needs to issue. So basically it comes down to this, how does a reactor incident progress? How existing systems and emergency measures affect an accident outcome? And how would an accident affect public health?

Case Study: Hanford Site

The Hanford Site is primarily a decommissioned nuclear production complex operated by the United States federal government on the Columbia River in Washington. It was established in 1943 as part of the Manhattan Project, where it was home to the B Reactor, the first full scale plutonium production reactor in the world. The plutonium manufactured at the site was used in the first nuclear bomb. During the Cold War, the project expanded to add on nine nuclear reactors and five large plutonium processing complexes, which were responsible for the production of more than 60,000 weapons in the US nuclear arsenal. Nuclear technology, during this time, advanced at a rapid rate and the Hanford scientists were responsible for producing major technological achievements. This in turn, led to a load of government documents confirming that Hanford's operations released significant amounts of radioactive materials into the air and the Columbia River.

The Hanford site was initially considered as the perfect site because it was a large and remote tract of land, had a space for laboratory facilities at least 8 miles from the nearest reactor, had no towns of more than 1000 people from the hazardous triangle, had no main highway or railway lesser than 10 miles from the hazardous triangle, had a clean water supply, a large electric supply and ground that could bear heavy loads. This lead to first large scale plutonium reactor in the world, the B-Reactor being built by DuPont and it originally operated at 250 megawatts. The reactor was graphite moderated and water cooled. Later on two identical reactors, F and D reactors came online. Initially, six reactors were proposed but then reduced to four and then three. Most of the reactors were shut down between 1964 and 1971, with an average individual life span of 22 years. The N reactor, which acted like a power grid to nearby villages, operated until 1987. Since then, most of the reactors have been entombed to allow the radioactive materials to decay and the surrounding structures were removed and buried. But as we can see, the whole thing wasn't a sure shot safety mechanism. The failure of doing a perfect job has, in turn, over the years, has led to a host of environmental problems and had affected the workers and people around.

The weapons production reactors were decommissioned at the end of the Cold War, and decades of manufacturing left behind 53 million US gallons (200,000 m^3) of high level radioactive waste stored within 177 storage tanks, an additional 25 million cubic feet (710,000 m^3) of solid radioactive waste, and 200 square miles (520 km^2) of contaminated groundwater beneath the site.

In 2011, Department of Energy (DOE) emptied 149 single-shell tanks by pumping nearly the entire liquid waste out into 28 newer double-shell tanks. DOE later found water intruding into at least 14 single-shell tanks and that one of them had been leaking about 640 US gallons (2,400 l; 530 imp gal) per year into the ground since about 2010. In 2012, DOE discovered a leak also from a double-shell tank caused by construction flaws and corrosion in the bottom, and that 12 double-shell tanks have similar construction flaws.[6]

[6] http://www.gao.gov/products/GAO-15-40

Questions a Resolution Must Answer

1. What are the security protocols in place in individual countries that utilize nuclear power, and how can these be updated and improved?
2. How effective have measures to prevent nuclear disasters been?
3. What methods must be implemented in order to increase efficiency of response in the event of a catastrophic nuclear disaster?
4. What technological advancements can be undertaken to control the spread of radiation or radioactive waste?
5. Considering nuclear energy is a long term substitute for coal and petroleum, to what extent and how can future technology be more prepared to tackle nuclear disasters?
6. How have past nuclear disasters and responses affected the outlook and ability of Member States to handle potential crises?
7. How can the IAEA itself become a stronger player in handling enforcement and compliance with security and safety norms?

Resources:

1. IAEA Charter: https://www.iaea.org/about/statute
2. Hanford Cleanup: Condition of Tanks May Further Limit DOE's Ability to Respond to Leaks and Intrusions from http://www.gao.gov/products/GAO-15-40
3. Safety of Nuclear Power Reactors. Retrieved February 20, 2017, from http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/safety-of-nuclear-power-reactors.aspx
4. Peaceful Uses of Nuclear Energy: Meeting Societal Needs. (2004, November 14). https://www.iaea.org/newscenter/statements/peaceful-uses-nuclear-energy-meeting-societal-needs
5. International Atomic Energy Agency (IAEA). Retrieved February 20, 2017, from http://www-ns.iaea.org/standards/concepts-terms.asp