Dear Delegates,

I would like to welcome you to the Southern Regional Model United Nations Conference (SRMUN) XXIII and the International Atomic Energy Agency (IAEA). It is an honor for me to serve as the Director of the IAEA at SRMUN this year. This is my fourth year with SRMUN and I look forward to the opportunity to mentor and teach the experience of Model UN as well as learn from your research and speeches. Each year on SRMUN staff is truly a more rewarding experience than the last.

The International Atomic Energy Agency, also recognized as "The Agency," was established shortly after U.S. President Eisenhower addressed the UN General Assembly on December 8, 1953 with his "Atoms for Peace" speech. Today, the IAEA conducts itself alongside the General Assembly and acts as the medium for which the international community seeks advice and assistance regarding the safe and secure use of fissile materials. In light of this year's theme, we have chosen the following topics to discuss at this year's conference due to their importance in responding and learning from crises and in achieving long-term sustainable development and global self-sufficiency.

I. One Year After Fukushima: Evaluating Improvements in Technological Safeguards to Protect the Global Population during a Disaster;
II. Utilizing Nuclear Techniques in Water Resource Management to Expand Water Access to a Growing Population; and
III. Examining the use of Nuclear Energy as a Viable Alternative to Natural Resources.

Each delegation is required to submit a position paper which covers each of the three topics. Position papers must be single spaced and should be no longer than two pages in length. The objective of the position paper is to describe your delegation's views and background regarding each topic, and to convince and persuade the members of your committee that the approach outline in your paper is the best course of action. The position papers are therefore critical in providing insight into the policies and positions of each country, and also providing insight into the direction each county will undertake in providing solutions to the challenges of this body.

Delegates are encouraged to use the position papers as an opportunity to state what your country intends to accomplish in this committee. Strong, well developed position papers are an excellent foundation for conference preparation. It is important to ensure all sides of each issue are adequately addressed and presented in a clear and concise manner that is easy for your audience to understand. More detailed information about how to write position papers can be found at the SRMUN website (www.srmun.org). **All position papers MUST be submitted by October 26, 2012, by 11:59pm EST using the submission system on the SRMUN website**.

I look forward to the opportunity to serve as the Director for the International Atomic Energy Agency during the 2012 Southern Regional Model United Nations. I wish you all the best of luck and look forward to working with each of you. Please feel free to contact Cortney, Nathaniel, Devon or myself if you have any questions.

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Committee History of the International Atomic Energy Agency

The history of the International Atomic Energy Agency ("IAEA") is intrinsically linked with the history of the development and application of fissile materials. The IAEA, also recognized as "The Agency," was established shortly after U.S. President Eisenhower addressed the UN General Assembly on December 8, 1953 with his "Atoms for Peace" speech.[1] The IAEA was developed with the idea of serving as an international agency that would assume control over fissile materials that are used both for nuclear power and for nuclear weapons. In October of 1956, an 81 member party of the Conference on the Statute of the International Atomic Energy Agency unanimously approved the Statute, thus formalizing the IAEA as an autonomous international body in 1957.[2] Support for the IAEA continued to grow, as did its capacity to serve as a strong regulatory body, as international, legally binding agreements on nuclear safety were ratified including the Treaty for the Prohibition of Nuclear Weapons in Latin America (the Tlatelolca Treaty of 1967), and the Treaty on the Non-Proliferation of Nuclear Weapons (NPT); made permanent in 1995.[3] Centered on three main objectives including nuclear verification, security and safety, and technology transfer,[4] the IAEA is the authoritative body on fissile materials, new research, and the viable application.

Headquartered in Vienna, Austria,[5] the IAEA meets annually for a General Conferences as outlined in Article V, Subsection A of the IAEA Statute.[6] Management of the Agency is conducted by a 35-member Board of Governors, elected by the General Conference, and a Director General, who is appointed by the Board of Governors with the approval of the General Conference. The Board of Governors is designated by Article VI of the IAEA Statute to include those countries with the most advanced atomic energy technologies, as well as 22 countries that proportionally represent each of eight geographical regions in the world.[7] The Board of Governors meets 5 times each year and makes recommendations regarding the IAEA's programme, membership, accounts and budget to the General Conference.[8] In turn, the Director General serves a four-year term as the chief administrative officer of the IAEA[9], along with six Deputy Director Generals who head the six main departments of the IAEA, and a secretariat staff of over 2,300 experts and professionals.[10]

Acting as the medium for which the international community seeks advice regarding the safe implementation on the use of fissile materials, the IAEA conducts itself alongside a number of UN institutions, and specifically submits reports to the UN General Assembly.[11] Where appropriate, the IAEA will also submit reports to the Economic and Social Council (ECOSOC) and the UN Development Programme (UNDP), [12]and in extreme matters that threaten international peace and security, the IAEA will notify and report to the UN Security Council.[13]

The work of the IAEA is divided into the agendas of six departments, furthering four main objectives: supporting research, exchanging information, setting standards and regulations, and the promotion of binding international conventions of nuclear safety.[14] The six departments[15] comprising the IAEA include:

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[1] History of the International Atomic Energy Agency, pg. 1, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf
[2] Ibid.
[3] Ibid., pg. 2
[4] A Short History of the IAEA, About the IAEA, http://www.iaea.org/About/history.html
[5] The International Atomic Energy Agency, http://www.iaea.org
[6] Article VI, IAEA Statute, http://www.iaea.org/About/statute.html
[7] Ibid.
[8] Article III, IAEA Statute. http://www.iaea.org/About/statute.html
[9] Article XII, IAEA Statute. http://www.iaea.org/About/statute.html
[10] Nuclear Safety and the Management of Nuclear Waste, History of the International Atomic Energy Agency, pg. 183, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf
[11] IAEA Departments, http://www.iaea.org/OurWork/
[12] Article III, IAEA Statute. http://www.iaea.org/About/statute.html
[13] Article XII, IAEA Statute. http://www.iaea.org/About/statute.html
[14] Nuclear Safety and the Management of Nuclear Waste, History of the International Atomic Energy Agency, pg. 183, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf
[15] IAEA Departments, http://www.iaea.org/OurWork/

The Department of Nuclear Energy, which seeks to enhance and encourage nuclear programming worldwide, specifically, by advising and assisting countries in meeting their demands for growing energy concerns and sustainable energy methods, and reviewing a country's development capabilities.[16]

The Department of Safeguards which oversees the adherence of Member States to their obligations in non-proliferation and contributes to nuclear arms control and disarmament.[17] The Department of Safeguards works by implementing a variety of safeguards, including traditional safeguards, implement and oversee nuclear material verification activities of IAEA members, and strengthening measures which encourages adherence to currently existing binding agreements and additional protocols.[18] Through the work of the Department of Safeguards, the IAEA commits Member States to declare present, absent, or unrecognized nuclear materials.[19]

The Department of Nuclear Safety and Standards which works to protect humans and the environment by enhancing a nuclear security framework that is capable of effectively responding to both manmade threats and natural disasters.[20]

The Department of Nuclear Sciences and Applications oversees the application of nuclear technology to aid Member States in developing a better relationship between sustainable energy and indigenous environments. In particular, the Department is involved in implementing the Nuclear Techniques for Development and Environmental Protection, which was the result of the 2002 World Summit on Sustainable Development in Johannesburg.[21] This Department addresses nuclear energy and its impact on these five key environmental areas: Water, Energy, Health, Agriculture and Biodiversity (also known as the WEHAB topics).[22]

The Department of Management consists of seven divisions that ensure the success of the general duties associated with running the organization, ranging from accounting and media relations to staff development and the timely acquisition of goods and services.[23] The divisions are as follows; Division of Budget and Finances, Division of General Services, Division of Conference and Document Services, Division of Human Resources, Division of Information Technology, Division of Public Information and the Office of Procurement Services.[24]

The Department of Technical Cooperation, which seeks to fulfill the IAEA's mandate to "accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world."[25] To carry out this mandate, the Department assists Member States in strengthening their nuclear programming through a variety of services such as knowledge sharing, training, fellowships, and workshops.[26] The Department reviews and approves projects on the regional and interregional level,[27] with a focus on reaching their Millennium Development Goals (MDG's).

The current members of the International Atomic Energy Agency include:

AFGHANISTAN, ALBANIA, ALGERIA, ARGENTINA, AUSTRALIA, AZERBAIJAN, BAHRAIN, BANGLADESH, BELARUS, BENIN, BOLIVIA, BOSNIA AND HERTZEGOVINIA, BRAZIL, BURKINA FASO, CAMEROON, CANADA, CHILE, CHINA, COLOMBIA, CONGO, COSTA RICA, CROATIA, CUBA, CZECH REPUBLIC, DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA, DOMOCRATIC REPUBLIC OF THE CONGO, DENMARK, EGYPT, EL SALVADOR, ESTONIA, FRANCE, GERMANY, CHANA, GREECE,

[16] About the Nuclear Energy Department: Our Role. IAEA. http://www.iaea.org/OurWork/ST/NE/Main/about.html
[17] What We Do. IAEA. http://www.iaea.org/OurWork/SV/Safeguards/what.html
[18] Ibid.
[19] Ibid.
[20] Nuclear Safety and Security: The Strategy. IAEA. http://www-ns.iaea.org/
[21] Report of the World Summit on Sustainable Development, A/CONF.199/20/Corr.1, Johannesburg, September 2002, http://www.un.org/jsummit/html/documents/summit_docs.html
[22] Nuclear Techniques for Development and Environmental Protection. Nuclear Sciences and Applications. IAEA. http://www-naweb.iaea.org/na/about-na/index.html
[23] Department of Management (MT). Employment. IAEA. http://www.iaea.org/About/Jobs/mt.html
[24] Ibid.
[25] Article II, IAEA Statute. http://www.iaea.org/About/statute.html
[26] What We Do. Technical Cooperation. IAEA. http://www.iaea.org/technicalcooperation/areas-of-work/index.html
[27] Ibid.

GUATEMALA, HAITI, HONDURAS, INDIA, INDONESIA, IRAN, IRAQ, ISRAEL, ITALY, JAPAN, JORDAN, KENYA, KUQAIT, LEBANON, LIBERIA, LIBYA, MAURITANIA, MEXICO, MOROCO, MOZAMBIQUE, MYANMAR, NEPAL NICARAGUA, NIER, NIGERIA, NORWAY, OMAN, PAKISTAN, PORTUGAL, QATAR, REPUBLIC OF KOREA, ROMANIA, RUSSIAN FEDERATION, SAUDI ARABIA, SERBIA, SOUTH AFRICA, SPAIN, SRI LANKA, SUDAN, SWEDEN, SWITZERLAND, SYRIA, THAILAND, TUNISIA, TURKEY, UGANDA, UKRAINE, UNITED ARAB EMIRATES, UNITED KINGDOM, UNITED REPUBLIC OF TANZANIA, UNITED STATES, URUGUAY, VENEZUELA, VIET NAM, YEMEN, ZAMBIA.

I: One Year After Fukushima: Evaluating Improvements in Technological Safeguards to Protect the Global Population during a Disaster

"…the problem is more about establishing safety norms than it is about the choice of nuclear energy, for this there is no alternative right now."

-President of the French Republic – Nicolas Sarkozy[28]

Introduction

As an increasing number of Member States within the international community are beginning to pursue nuclear programming, the IAEA is reevaluating current assistance mechanisms and provisions that continue to ensure nuclear safety and security worldwide. These measures are especially important in light of the 2011 nuclear incident at Fukushima, which resulted in the IAEA passing GC(55)/RES/9 in September 2011, recognizing "the need for urgent and longer-term responses and actions to be taken internationally…to make more robust [the] level of nuclear safety worldwide."[29] Nuclear safety comprises the IAEA's efforts to "help build national, regional, and international capacity to respond to nuclear and radiological incidents and emergencies."[30] The IAEA is mandated to further nuclear safety by its Statute, which states in Article III.A.6 that the IAEA will "establish, in consultation [with] specialized agencies, standards of safety, and to provide for the application of these standards at the request of parties and States [affiliated] within the field of atomic energy."[31] Through the IAEA, safety standards are developed by integrating and sharing knowledge, technology, and past experiences of the application of best practices,[32] which are a reflection on what the international community, "constitutes as a high level of safety for protecting people and the environment."[33]

The IAEA is the international authority in developing and maintaining a Nuclear Power Programme (NPP), with safety standards and safeguards procedures established for each stage of a NPP from initial conceptualization to decommissioning. The IAEA performs this work with the goal of preventing nuclear and radiological emergencies. The safety standards and safeguards are developed under the supervision of the IAEA's Commission on Safety Standards (CSS), which was first established in 1995. Meeting annually, the CSS prepares, reviews, and recommends changes to the safety standards and safeguards, which include: nuclear safety, radiation safety, transport, and management of radioactive waste.[34] The IAEA also addresses all aspects of emergency preparedness and response through two critical conventions which establish the legal basis for an international framework to facilitate information exchange and provide provisions in the event of a nuclear or radiological emergency.[35] Based

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[28] FORATOM. Fri. Apr. 1, 2011. http://www.foratom.org/quotes/815-sarkozy-31-march.html

[29] GC(55)/RES/9. *Measures to Strengthen International Cooperation in Nuclear, Radiation, Transport and Waste Safety*. The International Atomic Energy Agency: General Conference. September 2011. p. 2. http://www.iaea.org/About/Policy/GC/GC55/GC55Resolutions/English/gc55res-9_en.pdf

[30] Medium Term Strategy: 2012-2017. The International Atomic Energy Agency. p. 4. http://www.iaea.org/About/mts.html

[31] "The Statute of the IAEA" The International Atomic Energy Agency. http://iaea.org/About/statute.html

[32] *IAEA Safety Standards: Brochure*. The International Atomic Energy Agency. June, 2009. p. 2. http://www-ns.iaea.org/downloads/standards/iaea-safety-standards-brochure.pdf

[33] "IAEA Safety Standards." The International Atomic Energy Agency. January 17, 2012. p. 1. http://www-ns.iaea.org/standards/default.asp?s=11&l=90&w=1

[34] *Fourth Term Report: 2008-2011*. Commission on Safety Standards. 2011. p. 2-3. http://www-ns.iaea.org/committees/default.asp?s=5&l=37

[35] "Legal Basis." The International Atomic Energy Agency. January 17, 2012. p. 1. http://www-ns.iaea.org/conventions/emergency.asp?s=6

on these conventions, the Convention of Early Notification of a Nuclear Accident (Early Notification Convention), and the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency (Convention of Assistance), the IAEA established the Incident and Emergency Centre (IEC) in 2006.[36] The IEC now serves as "the global focal point for preparedness and response, providing 24 hours of information exchange and assistance."[37] The IAEA coordinates with a number of UN affiliated organizations to carry out the goals of Nuclear Safety and Emergency Preparedness and Response: the World Health Organization (WHO), the Food and Agricultural Organization (FAO), the World Meteorological Organization (WMO), and United Nations Security Council (UNSC).

Nuclear Power Plant Dai-ichi. Fukushima, Japan, March, 2011

Located in Fukushima, Japan, the Dai-ichi nuclear power facility is comprised of six light water reactors, making it one of the largest facilities in the world. The facility was designed to be high enough off the ground to avoid the possibility of flooding, though later analysis has shown that the plant designers did not appropriately evaluate or predict against the risks of all natural hazards.[38]

On March 11, 2011, a 9.0 magnitude earthquake and subsequent tsunami struck the eastern shore of Japan, immediately causing widespread destruction and massive fatalities. Seismic activity from the earthquake immediately caused three of the Dai-ichi facility's six reactors to shut down; the tsunami then created waves measuring over 8 meters to hit the facility.[39] The impact of these waves "exceeded all design basis limits" of the facility, as[40] knocking out 11 of the 13 Emergency Diesel Generators (EDGs), which provide backup power to the facility. As another EDG had already been shut down for maintenance, this left only one EDG remaining for almost 30 hours before also dying.[41] Without the necessary power of the EDGs to run the control rooms, which had also suffered severe damage, the six reactors became overheated and eventually went into full nuclear meltdown, causing widespread leaking of radioactive materials and the evacuation of a 12 mile-wide area around the plant.[42]

While considerable damage was done almost immediately, much of the concern regarding this nuclear crisis rests with the steps taken by the facility and the Japanese government over the following days, weeks and even months. On March 15, the Director General of the IAEA assembled the Fukushima Accident Coordination Team (FACT) to assess the situation in Japan.[43] FACT was comprised of two teams: the Fukushima Nuclear Safety Team (FNST) and the Fukushima Radiological Consequences Team (FRCT).[44] FNST focused on the integrity of the plant and planned for probable consequences, whereas FRCT analyzed and provided radiological data of the surrounding area.[45] The FACT Mission provided the most pertinent data, first presented in its *Preliminary Report*(between May – June, 2011) , and proved invaluable in shaping the *Final Report* that was presented at the IAEA's Ministerial Conference in Vienna in June, 2011. This report demonstrated that Japan had reacted in response to the situation at Fukushima in accordance with existing recommendations for radiation exposure,[46] putting into action methods that achieved the cooling of Spent Fuel Pools (SFPs) via closed loop circulations by the end of the month.[47] Cooling the

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[36] "Incident and Emergency Centre." The International Atomic Energy Agency. January 17, 2012. p. 1. http://www-ns.iaea.org/tech-areas/emergency/incident-emergency-centre.asp?s=1#1

[37] Ibid.

[38] "International Fact-Finding Mission Updates: May 22-June 1, 2011." Staff Report. The International Atomic Energy Agency. p. 2. http://iaea.org/newscenter/news/2011/japanmission.html

[39] *IAEA International Fact Finding Expert Mission of the Fukushima Dai-ichi NPP Accident Following the Great East Japan Earthquake and Tsunami*. The International Atomic Energy Agency. Vienna. June, 2011. p. 19. http://www-pub.iaea.org/mtcd/meetings/pdfplus/2011/cn200/documentation/cn200_final-fukushima-mission_report.pdf

[40] Ibid.

[41] Ibid.

[42] Ibid.

[43] "Fukushima Nuclear Accident, Information Sheet." Emergency Information Sheet. The International Atomic Energy Agency. 2011. p. 3. http://www.iaea.org/About/japan-infosheet.html

[44] Javier Yllera. "Technical Briefing: Summary of Reactor Unit Status." Incident and Emergency Centre. May 2011. http://www.slideshare.net/iaea/summary-of-reactor-unit-status-2-june-2011

[45] "Spent Fuel Storage in Pools and Dry Casks: Key Points and Questions & Answers." United States Nuclear Regulatory Commission. March 29, 2012. http://www.nrc.gov/waste/spent-fuel-storage/faqs.html

[46] "Fukushima Nuclear Accident, Information Sheet." Emergency Information Sheet. The International Atomic Energy Agency. 2011. p. 3. http://www.iaea.org/About/japan-infosheet.html

[47] Javier Yllera. "Technical Briefing: Summary of Reactor Unit Status." Incident and Emergency Centre. May 2011.

SFPs was crucial to mitigating further damage on-site, as the pools both cooled the nuclear fuel rods powering the nuclear facility, and helped contain the high heat and radiation given off by their usage[48] without the cooling and containment of the SFPs, the immediate area would have been exposed to radiation.

Nevertheless, data presented in the Final Report showed a failure to comply with IAEA safeguards and safety standards and that protective measures taken had provided "insufficient defense-in-depth provisions for tsunami hazards,"[49] which resulted in the Dai-ichi facility losing much of its "safety related equipment from the tsunami, and all off-site/on-site power, with the exception of one diesel operator at Unit 6."[50] This initial data suggested that while automated systems within the facility acted appropriately by successfully inserting all control rods upon detection of seismic activity,[51] there was still "wide-spread destruction, loss of heat-sinks, and a series of explosions [that had] occurred."[52] They further expressed the value of on-site Emergency Response Centers with adequate provisions for communications, essential plant parameters and resources.[53]

Today, the meltdown of the Dai-ichi nuclear power plant is considered to be one of the worst nuclear emergencies in world history, and the events of the incident have led to widespread plans to revisit nuclear disaster preparedness and response.

The Nuclear Power Programme

Member States face a number of challenges when developing a nuclear power program. To assist Member States in addressing these challenges, the IAEA has developed Technical Publications (also recognized as *TECDOCs*) to work in conjunction with published safety standards and safeguards in the planning of Nuclear Power Programmes (NPPs).[54] In assisting Member States in establishing and implementing NPPs, the IAEA has delineated three bodies as the responsible parties in the lifecycle of an NPP.[55] Additionally, the IAEA has delineated five stages in the NPP lifecycle, in addition to the preparatory work that is required to launch the NPP, including implementation of safety standards before, during and after the facility's operation.[56] In the first stage, the State develops an Action Plan for introducing a NPP into its national framework, taking into consideration financial and resource management and allocation.[57] The second phase commits the State towards recognizing the IAEA as the Regulatory Authority, by passing legislation through its governmental bodies.[58] The third phase determines the implementation of the facility's operator, also known as the Operating Organization, which will build and operate the nuclear facility via various regulatory approaches and qualifications as recommended by the IAEA.[59] After the IAEA has assisted a Member State in the development of a NPP's first three phases, it continues to provide assistance to both the State and the Operational Organization as they assume the majority of the responsibilities during and after operations commence.

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http://www.slideshare.net/iaea/summary-of-reactor-unit-status-2-june-2011

48 "Spent Fuel Storage in Pools and Dry Casks: Key Points and Questions & Answers." United States Nuclear Regulatory Commission. March 29, 2012. http://www.nrc.gov/waste/spent-fuel-storage/faqs.html

49 Ibid.

50 Ibid.

51 *IAEA International Fact Finding Expert Mission of the Nuclear Accident Following the Great East Japan Earthquake and Tsunami: Preliminary Summary*. The International Atomic Energy Agency. June 1, 2011. p. 2. http://www.iaea.org/newscenter/focus/fukushima/missionsummary010611.pdf

52 Ibid.

53 Ibid.

54 Nuclear Power Programme Planning: An Integrated Approach. The International Atomic Energy Agency. December, 2001. p. 2. http://www-pub.iaea.org/MTCD/publications/PDF/TE_1259_prn.pdf

55 Ibid.

56 *Specific Safety Guide (SSG-16). Establishing the Safety Infrastructure for a Nuclear Power Programme*. The International Atomic Energy Agency. December, 2011. p. 2. http://www-ns.iaea.org/downloads/ni/embarking/ssg-16.pdf

57 *Nuclear Power Programme Planning: An Integrated Approach*. The International Atomic Energy Agency. December, 2001. p. 4. http://www-pub.iaea.org/MTCD/publications/PDF/TE_1259_prn.pdf

58 *DS 424: A Roadmap for the Implementation of IAEA Safety Standards. The International Atomic Energy Agency*. August 2010. p. 13 & 22. http://www.iaea.org/NuclearPower/Downloads/Infrastructure/meetings/2010-08-23-27-RTWS/11.Roadmap-for-the-implementation-of-safety-standards.pdf

59 Ibid.

The fourth phase is considered the Operational lifetime of the NPP. During the facility's lifetime, the IAEA reviews the management of the facility by the Member State and the Operating Organization. The IAEA conducts this review through its own Integrated Regulatory Review Service (IRRS), which is "designed to strengthen and enhance the effectiveness of the national regulatory infrastructures of State", by identifying trends and challenges through an objective comparison to the IAEA's international standards.[60] Supporting the IRRS is the Operational Safety Review Team (OSART), established in 1982, which reviews factors "affecting the management of safety and the performance of personnel."[61] OSART address eight areas of operational safety including plant management, personnel training, operation, maintenance, technical support, radiation protection, chemistry and emergency planning and preparedness, by comparing practices of the current facility, with other successfully running facilities.[62] This culminates in Guidelines published by Peer Review of Operational Safety Performance Experience (PROSPER), so that NPPs can benefit from shared knowledge of good practices.[63]

Phase 5 of the NPP deals specifically with the decommissioning process of nuclear facilities. In the fall of 2007, the IAEA launched a new "Network" to address recommendations made at the IAEA General Conference in 2006 in Athens, Greece.[64] This International Decommissioning Network (IDN) coordinates decommissioning initiatives within and outside of the agency. Managed by The IAEA Department of Technical Cooperation, IDN is provisioned to improve, through training exercises, the same termination of nuclear activities.[65] Through detailed outlining of NPPs, the IAEA brings together standards and safeguards working in conjunction to reach fully efficient and safe operations of nuclear facilities.

Emergency Preparedness and Response

Since 2005, the IAEA, with the creation of the Incident and Emergency Centre, has gradually improved methods that ensure worldwide event reporting, information exchange, and the coordination of assistance deployed to Member States.[66] The IEC has two departments in place that prepare for, assess, and address future emergencies: Emergency Preparedness, and Inter-Agency Matters. The Emergency Preparedness Department relies on the provisions of the Assistance Convention, to provide on-site response assistance.[67] The Inter-Agency Matters Department has in place a working international response system, the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), which coordinates a working relationship between The Agency and IGOs in the event of an emergency. IACRNE develops and implements a Joint Radiation Emergency Management Plan of International Organizations (JPLAN), prepares the Response Plan for Incidents and Emergencies (REPLIE) for the IAEA, and hosts emergency preparedness exercises (ConvEx).[68] While JPLAN defines the roles and responsibilities of States and Operating Organizations in the event of a nuclear emergency, REPLIE defines how the IAEA will act in relationship to them.[69] In order to ensure the best possible emergency response practices, the international community participates in ConvEx drills and exercises. Three types of ConvEx exercises currently exist: ConvEx-1 tests communications, ConvEx-2 assess response times, and ConvEx-3 exercises the full operational readiness of information exchange mechanisms worldwide.[70] The most recent ConvEx exercise was held in 2008, testing

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[60] "Integrated Regulatory Review Service." The International Atomic Energy Agency. March 22, 2012. pp. 1-2. http://www-ns.iaea.org/reviews/rs-reviews.asp

[61] "Operational Safety Services." The International Atomic Energy Agency. April, 04, 2012. p. 1. http://www-ns.iaea.org/reviews/op-safety-reviews.asp#osart

[62] Ferdinand L. Franzen. "Reviewing the Operational Safety of Nuclear Power Plants." The International Atomic Energy Agency. April 1987. p. 13. http://www.iaea.org/Publications/Magazines/Bulletin/Bull294/29402041316.pdf

[63] "Operational Safety Services." The International Atomic Energy Agency. April, 04, 2012. p. 2. http://www-ns.iaea.org/reviews/op-safety-reviews.asp#osart

[64] "International Decommissioning Network." The International Atomic Energy Agency. January 23, 2012. p. 1. http://www.iaea.org/OurWork/ST/NE/NEFW/WTS-Networks/IDN/overview.html

[65] *International Decommissioning Network: The Brochure*. The International Atomic Energy Agency. http://www.iaea.org/OurWork/ST/NE/NEFW/WTS-Networks/IDN/idnfiles/IDN-Brochure.pdf

[66] "Incident and Emergency Centre." The International Atomic Energy Agency. January 17, 2012. pp. 1-2. http://www-ns.iaea.org/tech-areas/emergency/incident-emergency-centre.asp?s=1#1

[67] "Emergency Preparedness." The International Atomic Energy Agency. January 17, 2012. http://www-ns.iaea.org/tech-areas/emergency/preparedness.asp?s=1&l=1

[68] "International Response System: Inter-Agency Matters." The International Atomic Energy Agency. January 17, 2012. pp. 1-3. http://www-ns.iaea.org/tech-areas/emergency/inter-agency-matters.asp?s=1&l=4

[69] Ibid.

[70] "Incident and Emergency Centre." The International Atomic Energy Agency. January 17, 2012. p. 2.

Member States and IGOs in a severe nuclear accident. The benefit of these drills lies in the post reviews of emergency preparedness, so that the international community can optimize resource utilization, recognize good practices, and highlight areas for improvement.[71]

Environmental factors are also an important facet in preventing and preparing for nuclear emergencies. In the earlier stages of developing a NPP, the IAEA utilizes guidelines presented in their *Safety Assessment of Nuclear Installations* series, to tailor which defense-in-depth strategies best take into account site characteristics, environmental and man-made, for the projected long-term feasibility and safe operation of an NPP.[72] One prominent issue with this process is that much of the planning is guesswork, as the long-term safety aspect attempts to address "uncertainties [in] the quantitative estimates of repository performance with other quantitative evidence that the repository will provide isolation of the wastes."[73] IAEA experts turn to proven Defense-in-depth strategies, as highlighted through ConvEx exercises to, "compensate for potential human and component failures…so that each design is fail-safe.[74] Defense-in-depth also takes into account results generated by computer simulated Safety Analysis, categorizing Postulated Initiating Events (PIEs), that predict how structural containment barriers may be challenged, and focus on binding cases with common dominant internal / external hazards.[75]

The IAEA Safety Analysis reporting of PIEs also takes into account three Fundamental Safety Functions (FSFs), which are vital in the development of the facilities Defense in-depth strategies. Properly implemented Defense in-depth strategies protect FSFs, as they: control radioactivity, constantly cool the core, and shape the confinement of radioactive materials.[76]

Improving the IAEA Nuclear Safety Framework, Standards and Safeguards

Using Fukushima as a backdrop, the IAEA is working to identify and improve the quality and speed of assistance in the event of a nuclear or radiological incident. Following the *Final Report* presented during the IAEA's Ministerial Conference in June 2011, Resolution GOV/2011/59-GC(55)/14 was adopted, that implemented an international action plan to assess areas and improve all aspects of the Nuclear Safety infrastructure within the IAEA over a two year period.[77] The next Ministerial Conference will be a jointly hosted effort between Japan and IAEA in December 2012, reporting on progresses made regarding: emergency preparation and response, transparency between the IAEA and affiliates, MS assessments of their respective nuclear power plants, nuclear safety, and harmonizing the legal conventions.[78] After the conference, IAEA experts and experts in the field will continue to facilitate an exchange of information that will culminate in current and future NPPs implementing improved safety standards and safeguards into their nuclear facilities.

In preparation for the 2012 Ministerial Conference, a number of IAEA guides that were published just before, or completed right after the disaster, are now also under review to better incorporate the experiences gained from Fukushima to improve aspects of Nuclear Safety and Emergency Preparedness and Response. Prior to the disaster, in 2010, the IAEA put into effect a new process for streamlining the incorporation of IAEA safety standards into NPPs, now known as the *DS 424: Roadmap for the Implementation of IAEA Safety Standards*, bridging both the IAEA's "Milestones" and IAEA Safety Standards Fundamentals and Requirement Guides.[79] In doing so, there is a greater emphasis placed solely on NPPs safety, covering the design safety, safety assessment, and preparation for

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http://www-ns.iaea.org/tech-areas/emergency/incident-emergency-centre.asp?s=1#1

[71] "International Response System: Inter-Agency Matters." The International Atomic Energy Agency. January 17, 2012. p. 5. http://www-ns.iaea.org/tech-areas/emergency/inter-agency-matters.asp?s=1&l=4

[72] *Safety Assessment of Nuclear Installations*. IAEA/ICPT School of Nuclear Energy Management. August, 2011. p. 20. www.iaea.org/inisnkm/nkm/pages/2011/.../topics/topic7/07_J.Yllera.pdf.

[73] Ibid.

[74] Ibid.

[75] Ibid.

[76] Ibid.

[77] *GOV/2011/59-GC(55)/14. Draft IAEA Action Plan on Nuclear Safety*. The International Atomic Energy Agency. September 5, 2011. http://www.iaea.org/About/Policy/GC/GC55/Documents/gc55-14.pdf

[78] Ibid.

[79] *DS 424: A Roadmap for the Implementation of IAEA Safety Standards*. The International Atomic Energy Agency. August 2010. p. 10. http://www.iaea.org/NuclearPower/Downloads/Infrastructure/meetings/2010-08-23-27-RTWS/11.Roadmap-for-the-implementation-of-safety-standards.pdf

commission. The IAEA, through DS 424, details and fleshes out necessary safety requirements that tailor NPPs to a Member State's unique guidelines and policy framework.[80] In September 2011, the IAEA completed the Unified System for Information Exchange in Incidents and Emergencies (USIE), a website aiming to harmonize legal provisions stated in the Emergency Notification and Assistance Conventions (ENAC).[81] The IAEA's G*eneric Reactor Safety Review Projects* (GRSRs) framework, finalized one year after Fukushima in March 2012, is another document published in the Nuclear Installation Safety (NINS) series, which could play a vital role to the development of safeguards and safety standards into an NPP. Through the GRSR, the safety guide will address the IAEA's 15 critical safety requirements through informed design and assessment guidelines.[82] Utilized during the second phase of an NPP, it will serve to act as an "early" evaluation of a Member States submitted NPP proposal.[83]

Conclusion

It is imperative for all involved participants to take lessons learned from Fukushima to make nuclear safety standards more robust. The IAEA is at a critical junction in time, where improvements made in the area of nuclear safety is key, as it will influence the decisions of Member States to/or not to pursue the implementation of an NPP. Learning from Fukushima presents the international community a new paradigm of research and development, aimed squarely at improvements to be made in the field of nuclear safety. The IAEA safety standards and their implementation, and aspects of emergency preparedness and response have recognized gaps that need to be addressed. Member States worldwide need to take these under review as they move forward with their own NPP undertakings. This period of review and reformation isn't just short-term, but should be recognized as an ongoing organic process.

Committee Directive

It is important to keep in mind what gaps are present within the Nuclear Safety framework of the IAEA as you deliberate with your fellow Delegates on how best to resolve the topic within committee session. What is currently being discussed? What is being neglected? Improving on-site emergency response facilities was a recommendation made by experts in the *Final Report* on Fukushima,[84] yet is overlooked in the Action Plan Resolution. The Action Plan itself lends itself to be very broad and all encompassing, should it be narrowed as you plan for 2013's Ministerial Conference? As Member States with NPPs, have your facilities seen improvements in design or operations, taking into account the findings from the *Final Report*? For those Member States looking to pursue, or are pursuing the development of an NPP, have the changes or lack thereof hindered you in this undertaking? How can the IAEA provide guidance and continue to act as the international authority regarding NPPs, especially in phases four and five, without infringing on State sovereignty?

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[80] *GC(55)/RES/9. Measures to Strengthen International Cooperation in Nuclear, Radiation, Transport and Waste Safety*. The International Atomic Energy Agency: General Conference. September 2011. p. 13. http://www.iaea.org/About/Policy/GC/GC55/GC55Resolutions/English/gc55res-9_en.pdf

[81] *IAEA Generic Reactor Safety Review Projects (GRSR*). The International Atomic Energy Agency: Division of Nuclear Installation Safety. March, 2012. p. 11. http://www.iaea.org/INPRO/cooperation/6th_GIF_Meeting/presentations/GRSR-Yllera.pdf.

[82] Ibid.

[83] *Safety Assessment of Nuclear Installations.* IAEA/ICPT School of Nuclear Energy Management. August, 2011. pp. 37-40. www.iaea.org/inisnkm/nkm/pages/2011/.../topics/topic7/07_J.Yllera.pdf.

[84] *IAEA International Fact Finding Expert Mission of the Fukushima Dai-ichi NPP Accident Following the Great East Japan Earthquake and Tsunami.* The International Atomic Energy Agency. Vienna. June, 2011. p. 16. http://www-pub.iaea.org/mtcd/meetings/pdfplus/2011/cn200/documentation/cn200_final-fukushima-mission_report.pdf

II. Utilizing Nuclear Techniques in Water Resource Management to Expand Water Access to a Growing Population

"By becoming more knowledgeable about your own resources, not only do you improve your water use and availability, but you are also better able to deal with and cooperate with your [neighbors] who share your resource,"
- Charles Dunning, Water Resources Advisor in the IAEA's Isotope Hydrology Section[85].

Introduction

In recent years, the international community has adopted the understanding that water is a crucial fact to sustainable development, which has been made a top priority for all Member States and UN bodies over the coming years by the current Secretary-General of the United Nations.[86] Notably, the Rio+20 United Nations Conference on Sustainable Development (Rio+20), which took place in June 2012,[87] identified water as one of seven 'critical concerns' requiring the immediate attention of the international community in furthering sustainable development. Water is crucial to development as a growing source for renewable energy and an essential element for growing crops. Moreover, research has shown how the lack of clean water, combined with an ever growing global population, continues to threaten development efforts.[88]

Water was also highlighted as a critical need in the Millennium Development Goals (MDGs) that were adopted in 2000 in New York City. The eight MDGs were established to improve key areas in the quality of life for all humans by focusing on the most critical needs that the global community must address in the twenty-first century. Within the seventh MDG, which pertains to environmental sustainability, the international community has pledged to decrease the number of individuals without access to drinking water by half.[89] Secretary General Ban Ki-moon marked the 2012 World Water Day by noting that "Over the coming decades, feeding a growing global population and ensuring food and nutrition security for all will depend on increasing food production. This, in turn, means ensuring the sustainable use of our most critical finite source, water."[90]

The 2012 Millennium Development Goals Report have shown Member States that the specific target within MDG 7 of reducing by half the number of people without access to potable water, was in fact met in 2010, and that over 2 billion people gained this access between 1990 and 2010.[91] However, although much has been done to date to increase access to clean water, estimates show that 783 million people worldwide are still without this essential resource.[92] The 2012 Millennium Development Goals Report additionally notes that rural areas are much further behind in gaining access to clean water than urban areas, and that many populations must still travel a distance to access this water.[93] Therefore, while considerable progress has been made, there is still much work to be done to ensure that all people have access to clean, safe water.

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85 "The World is Thirsty." The International Atomic Energy Agency. 22 Mar. 2012. http://www.iaea.org/newscenter/news/2012/worldthirsty.html
86 "Ban Ki-moon highlights sustainable development as a top priority." Department of Economic and Social Affairs. January 6 2012. http://www.un.org/en/development/desa/news/nocat-uncategorized/sg-visits-desa.html
87 Rio+20. The United Nations Conference on Development. http://www.uncsd2012.org/
88 Water and the Environment. The International Atomic Energy Agency: Technical Cooperation Programme. http://www.iaea.org/technicalcooperation/documents/Factsheets/Water-Eng.pdf
89 "We Can End Poverty 2015 Millennium Development Goals: Ensure Environmental Sustainability: Goal 7." The United Nations. http://www.un.org/millenniumgoals/environ.shtml.
90 Ensuring access to water for agricultural vital for sustainable future – UN. UN News Center. http://www.un.org/apps/news/story.asp?NewsID=41605&Cr=Water&Cr1=Sanitation
91 *The Millennium Development Goals Report: 2012.* The United Nations. Page 52. http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2012/English2012.pdf
92 Ibid., pg 52.
93 Ibid.,pg 53-54.

Nuclear Involvement in Water Resource Management

Though a seemingly unlikely tool for addressing this issue, the IAEA actually has the ability to be valuable resource in extending access to clean drinking water. Specifically, the IAEA can act within its mandate to assist Member States in managing their water resources by developing isotopic techniques used to track water sources; evaluating soil degradation, identifying the quality of water, and protecting marine life.[94]

The IAEA statute states that the Agency shall seek to accelerate and enlarge the contribution of atomic energy for peace, health and prosperity throughout the world.[95] Much of this work is performed within the IAEA's Technical Cooperation Programme, which is jointly operated by the IAEA Secretariat and Member States, with contributions made by several IAEA Departments.[96] With respect to natural resources, the Technical Cooperation Programme promotes the use of nuclear technology to manage and efficiently optimize these resources, specifically by aiding in the sharing of information between Member States.[97] The IAEA Technical Cooperation Programme provides assistance in projects and training to Member States in the categories of soil and agriculture water management through irrigation and water source quality, the tracking of groundwater sources, as well as the preservation of marine life.[98] The IAEA has additionally established the Water Resources Programme (WRP) to provide Member States with information and technical assistance to help Member States understand the water cycle and the application of nuclear technology to increase access to fresh water throughout different phases of the water cycle.

Isotope Hydrology

Within the Water Resources Programme is the Isotope Hydrology Section (IHS), which is the body that carries out the projects and programs adopted by the IAEA Water Resources Programme.[99] Isotope Hydrology is premised on the study of the isotopes of hydrogen and oxygen, the two elements of which water is comprised.[100] Through study of the characteristics of these isotopes, scientists may better understand the source of water in any given region and track the creation of a given body of water.[101] Over the past 10 years, the IAEA has funded and supported over 160 projects related to isotope hydrology in 63 Member States[102] and has additionally the Isotope Hydrology Laboratory in Vienna, Austria, which continues to develop applications for this science, under the purview of the IHS.[103] Past projects conducted in Ethiopia, Sub-Saharan Africa, and Latin America have been successful in changing the way that Member States perceive water resource management and have also enabled access to clean water for both personal and agricultural usage.

In fulfillment of the IAEA's mission to provide scientific and technical information to Member States, the WRP has additionally established a database of information called the Isotope Hydrology Information system (IHIS), which contains information for three major IAEA isotope monitoring programmes: the Global Network of Isotopes in Precipitation (GNIP), the Global Network of Isotopes in Rivers (GNIR), and the Moisture Isotopes in the Biosphere and Atmosphere (MIBA).[104] The GNIP pertains to monthly isotope data from GNIP-event stations which collect event based samples and GNIP-vapor stations which collect data on isotopes in water vapor. The GNIR

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[94] Contributing to the Achievement of the Millennium Development Goals. The International Atomic Energy Agency. http://www.iaea.org/technicalcooperation/documents/Factsheets/IAEA-MDGs-Eng.pdf
[95] Technical Cooperation Programme. Technical Cooperation. IAEA. http://www.iaea.org/technicalcooperation/programme/index.html
[96] Ibid.
[97] Water and the Environment. Technical Cooperation. IAEA http://www.iaea.org/technicalcooperation/areas-of-work/water-environment/index.html
[98] Ibid.
[99] "About Us: Introduction to Isotope Hydrology Section" The International Atomic Energy Agency Water Resource Programme. http://www-naweb.iaea.org/napc/ih/IHS_about_us.html
[100] Ibid.
[101] Ibid.
[102] "Managing Water Resources – IAEA Technical Co-operation A Partner in Development." The International Atomic Energy Agency Technical Cooperation Programme. http://www.iaea.org/Publications/Booklets/TcDevelop/two.html
[103] Ibid.
[104] "Water Isotope System for Data Analysis, Visualization, and Electronic Retrievel." The International Atomic Energy Agency. Water Resources Programme. http://www-naweb.iaea.org/napc/ih/IHS_resources_isohis.html

encompasses information on the isotope records for a number of worldwide rivers and these statistics are available on the IHIS database.[105] The MIBA contains the work of several scientists researching a wide range of topics including local ecosystems and isotopic research on a global scale.[106] All the data within the IHIS can be accessed and downloaded in visual representations, graphs, and maps through the Water Isotope System for Data Analysis, Visualization, and Electronic Retrieval (WISER) software available to Member States.[107] The development and design of the WISER application and IHIS database are strong indications of the IAEA's dedication to sharing information between agencies and Member States in order to promote uniform progress in water resource management.

Freshwater Availability

While over seventy percent of the world is covered in water, only three percent of this number is considered freshwater,[108] and of the total freshwater supply, less than one percent is considered accessible for human use, as most freshwater is trapped in ice caps or at inaccessible depths beneath the surface of the Earth.[109] The limited availability of accessible freshwater is compounded by the fact that over the next two decades, demand for clean freshwater is expected to increase by 40 percent.[110] These facts demonstrate the need to do more in order to sustain current levels of water access to the global population through better management of this delicate natural resource. Estimates show that if we do not work harder to increase population's access to water, two-thirds of the world's population will live in countries with drastic shortages in freshwater for drinking and agriculture.[111]

The majority of drinking water is currently derived from groundwater as much of the world's surface water has evaporated due to desertification and extreme drought caused by climate change.[112] Member States within Africa and South America are the most affected by this alteration in source of drinking water.[113] Understanding the timing of replenishment of underground water sources as well as direction and speed of flow is therefore essential in determining optimal areas to drill wells for access to the water by individuals.[114] An example of the importance of understanding the sources of groundwater is the Nubian Aquifer, which lies beneath the surface of much of Egypt and Libya and the northern parts of Chad and Sudan. This aquifer is sourced from the Nile River and is a major source of drinking water for many residents of these Member States.[115]

The IAEA uses isotope hydrology to further progress in expanding access to water by tracking sources of freshwater and determining the quality of such sources. As discussed above, the isotopes of a water molecule can indicate the origin of the source of a water molecule.[116] Additionally, synthetic radioactive isotopes also called 'tracers' are also used to track resource flow and reservoir leakage or contamination.[117] The usage of isotope hydrology has also

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[105] Ibid.

[106] "IAEA-MIBA Moisture Isotopes in the Biosphere and Atmosphere." The International Atomic Energy Agency Water Resources Programme. http://www-naweb.iaea.org/napc/ih/IHS_resources_miba.html

[107] "Water Isotope System for Data Analysis, Visualization, and Electronic Retrievel." The International Atomic Energy Agency Water Resources Programme. http://www-naweb.iaea.org/napc/ih/IHS_resources_isohis.html.

[108] "Managing Water Resources – IAEA Technical Co-operation A Partner in Development" The International Atomic Energy Agency Technical Cooperation Programme. http://www.iaea.org/Publications/Booklets/TcDevelop/two.html.

[109] *Managing Water Resources using Isotope Hydrology*. The International Atomic Energy Agency. http://www.iaea.org/Publications/Factsheets/English/water.pdf.

[110] Ibid.

[111] Ibid.

[112] "Our Work: Isotopic techniques help to improve the management of water resources in Sub Saharan Africa." The International Atomic Energy Agency. http://www.iaea.org/technicalcooperation/Home/Highlights-Archive/Archive-2012/22032012-Water-_Sahel.html

[113] Ibid.

[114] Felicity Barringer. "A Rare Isotope Helps Track an Ancient Water Source". NY Times. http://www.nytimes.com/2011/11/22/science/rare-krypton-81-isotope-helps-track-water-in-ancient-nubian-aquifer.html?_r=2&src=dayp.

[115] Ibid.

[116] Managing Water Resources using Isotope Hydrology. The International Atomic Energy Agency. http://www.iaea.org/Publications/Factsheets/English/water.pdf.

[117] Introduction to Isotope Hydrology. The International Atomic Energy Agency. http://www.iah.org/downloads/pubfiles/V25prelim.pdf

allowed researchers to design the spacing of wells in such a way as to avoid rapid depletion of the essential water source.[118] With respect to the Nubian Aquifer, a rare isotope named krypton 81 has helped researchers identify key information about the aquifer, which in turn has aided in understanding the rate of replenishment of the aquifer from the Nile compared with usage from wells in Libya and Egypt. The subsequent placement of wells in the region can help prevent the contamination of the freshwater source by saltwater drawn into the aquifer due to hydrologic depression caused by heavy pumping in areas near a coastline.[119]

Improving access to drinking water through isotopic hydrology is a key mission of the IAEA. The Isotope Hydrology Laboratory in Vienna supports many multi-national development activities such as the work with the Nubian Aquifer to promote the usage of isotope technology in the quest for sustainable water resource management.[120] Regional and sub-regional cooperation and technology sharing is essential to ensure sustainable development in water management. Most sources of water and the subsequent flow of said water do not lie within the political borders of a country, so it is crucial that Member States work together to utilize isotopic technology to efficiently pump from water sources and determine optimal placement of wells, and also to agree to share the sources and abide by pumping regulations. The IAEA supports this work by working with Member States to provide training, publications, activities, and capacity building, both human and infrastructure capital.[121] It is only through the continued support of the IAEA Water Resources Programme, regional and sub-regional cooperation, and an increase in technology and knowledge sharing that true sustainable development in water resource management can be obtained.

Agriculture and Food Scarcity

Safe water for populations and livestock, quality water for crops and maintenance of agriculture land is essential to the sustained development of a Member State.[122] Estimates show that in many regions of the world, a Member State's agriculture vertical requires the use of up to 80 percent of a country's freshwater supply.[123] Most of the water supplied to a crop is through rainfall and moisture present in the soil.[124] Due to climate change causing significant alterations in seasonal rainfalls and thereby extensive droughts in parts of the world, there is an increasing number of Member States without the necessary amount of rainfall or soil moisture to support agricultural productivity.[125] In developing Member States where food scarcity is already an issue, a lack of water for agricultural use further hurts the economies of these countries who must look first to the challenging feat of feeding their own people before considering their crops for export. Nuclear techniques can improve agriculture and food scarcity through soil moisture and contamination monitoring for proper irrigation scheduling and assisting regions in selecting crops which will produce the largest amount of product for climate and soil composition.[126]

Irrigation is one avenue through which the IAEA, in conjunction with the Food and Agriculture Organization (FAO), can assist Member States in increasing agricultural productivity. For most developing Member States, non-irrigated crops currently equate to 60 percent of over-all agriculture production,[127] but irrigation, the process of using artificial means to water crops (as opposed to rainwater) can aid in increasing the production of agriculture and maintenance of livestock. While irrigation only provides ten percent of the water normally needed to maintain an agricultural area, the presence of an irrigation system can increase the productivity of the land three-fold.[128] This

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[118] Ibid.
[119] Ibid.
[120] Introduction to Isotope Hydrology. The International Atomic Energy Agency. http://www.iah.org/downloads/pubfiles/V25prelim.pdf
[121] Ibid.
[122] Water and the Environment. The International Atomic Energy Agency: Technical Cooperation Programme. http://www.iaea.org/technicalcooperation/documents/Factsheets/Water-Eng.pdf
[123] Water Use Efficiency in Agriculture: The Role of Nuclear and Isotopic Techniques. The International Atomic Energy Agency. http://www.iaea.org/About/Policy/GC/GC51/GC51InfDocuments/English/gc51inf-3-att1_en.pdf
[124] Ibid.
[125] Ibid.
[126] Ibid.
[127] Ibid.
[128] Ibid.

increase in productivity is essential in decreasing food scarcity within a Member State, as governments look to produce more food with less water.

The Sahal region of Africa provides an example of how the IAEA has worked to combine nuclear technology and irrigation systems in order to improve food scarcity issues prevalent in the region. Lying between the Sahara desert and the sub-Saharan tropical area of the African continent, the Sahal region has a particularly scare water supply. By applying a process involving soil moisture neuron probes (SMNPs) to drip irrigation processes, the Water Resources Programme has enabled the region to put less strain on the soil of the agriculture area and aid Member States in optimizing their usage and allocation of water for agriculture.[129] This was accomplished through the use of the SMNPs to calculate moisture levels present in soil and the number of water molecules removed from the soil due to evaporation and plant transpiration. SMNPs are comprised of two parts, a probe containing sealed radioactive source which emits fast neutrons and an electronic counting system which counts slow moving neutrons.[130] The fast neutrons are emitted and scattered into the soil once the probe is placed into the ground. Hydrogen present within soil moisture slows the neutrons and the electronic counting system then counts the number of slow neutrons thereby determining the amount of moisture in the soil.[131] For the Sahal region, SMNPs were used to identify the precise amount of water that specific plants required to properly grow and yield product.[132] With this knowledge, drip irrigation systems were developed to apply the exact amount of water identified for a particular plant directly to the plant's roots, thereby avoiding evaporation or leakage.[133] The combination of nuclear technology with the benefits of irrigation have not only increased crop yields thereby improving food scarcity in the Sahal region, but also promote the sustainable economic development of the region as families are able to sell crops and obtain income. The implementation of this technology in developing Member States such as those in the Sahal region have shown to increase crop production by as much as 50 percent over previous irrigation techniques.[134]

Soil quality monitoring is another tactic for increasing productivity by helping to prevent soil degradation and land degradation, which cause agriculture areas to become barren, and adds to food scarcity. Poor farming techniques and resource management are the general causes of erosion, which contaminates water sources with both saline and pesticides. Most Member States have regulations against the sale of produce which exceed set maximum residue limits (MRLs) across borders.[135] The problem lies in the fact that many farmers will still sell produce that exceeds MRL locally, thus causing health threats to local populations.[136] In fact, soil degradation has become so concerning that the United Nations recently named the issue as one of the most challenging barriers to sustainable food production and water resource management for the 21st century.[137] To combat this problem, the IAEA's Water Resource Programme supports Member States in trapping and static pressing specific isotopes to monitor agricultural pollutants such as pesticides and animal manure. The entrance of these pollutants into the soil and water sources through runoff subsequently leads to further land degradation, which in turn leads to potential health issues for humans, livestock, and the environment.[138] But by employing isotopic techniques, Member States can monitor the amount of chemicals in water, soil, and produce in order to help reduce the amount of pesticides entering the soil and water sources. The nuclear technology discussed above could not be effective without regional and sub-regional cooperation in regards to technology, education, and methods of study. Increased education on human consumption and implementation of nuclear technologies continue to occur in an efficient and rapid manner in order to meet and exceed the rising demand for scarce water sources.

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[129] Ibid.
[130] Ibid.
[131] Ibid.
[132] "Our Work: Isotopic techniques help to improve the management of water resources in Sub Saharan Africa." The International Atomic Energy Agency. http://www.iaea.org/technicalcooperation/Home/Highlights-Archive/Archive-2012/22032012-Water-_Sahel.html.
[133] Ibid.
[134] Water Use Efficiency in Agriculture: The Role of Nuclear and Isotopic Techniques. The International Atomic Energy Agency. http://www.iaea.org/About/Policy/GC/GC51/GC51InfDocuments/English/gc51inf-3-att1_en.pdf.
[135] Ibid.
[136] Ibid.
[137] Water and the Environment. The International Atomic Energy Agency: Technical Cooperation Programme. http://www.iaea.org/technicalcooperation/documents/Factsheets/Water-Eng.pdf
[138] Ibid.

Desalination Efforts

Nuclear technology can also be used within the process of desalination – defined as turning salt water or brackish water into freshwater using nuclear technology in an integrated facility.[139] As Member States lose access to fresh drinking water due to increasing water scarcity, many are turning to desalination as a means to provide this essential resource to their populations. The majority of desalination plants utilize the process of reverse osmosis (RO) via electric pumps—this is a very energy intensive process.[140] Israel provides ten percent of its drinking water via desalination using reverse osmosis while Singapore has recently contracted to add a RO plant to its desalination process to supplement the large plant commissioned in 2005.[141] Malta, Algeria, the UAE, China, and other Member States also work to provide fresh portable water to its citizens and agriculture industry via desalination plants. Beginning in 1998 the IAEA coordinated research with over 20 countries in order to review existing nuclear plants to couple facilities with desalination technologies. This programme is still in progress and the IAEA is working to reduce the cost of the desalination process and make the technology more available to drought-stricken Member States.[142]

One significant problem is that many Member States face issues regarding the feasibility of the financial investment necessary in the infrastructure and upkeep necessary to maintain a desalination facility.[143] The IAEA has generated the Desalination Economic Evaluation Program (DEEP) in order to analyze the cost and performance of implementing a desalination program into a local economy.[144] The desalination process typically contains the use of fossil fuels and DEEP also works to analyze different plant types, selection of fossil fuels, and various processes of desalination.[145] This tool is important to Member States looking for options to increase the amount of freshwater available to their populations and agriculture. The IAEA is also working with Member States to implement renewable energy sources into the desalination process in lieu of fossil fuels. For example, a new RO plant in Australia is powered by a windfarm and the IAEA remains hopeful that the reduced use of fossil fuels will help make RO a more sustainable process and potentially more cost-effective.[146] The IAEA has developed tools and programs including DEEP which aid in the desalination process; however, more work and research is needed to better understand how to implement these tools in more nations, as well as the over-all effects to ecosystems natural to saltwater.

Marine Life Protection

Marine pollution is another area in which nuclear technology can make a difference. Marine pollution causes a serious threat to marine life as well as to local industries, as the quality of a Member State's exports are directly correlated with the success of the trade in the short term and the ability of a country to identify the quality of marine export is essential to the success of the trade in the long term.[147] Similar to isotopes used to measure the quality of water sources described above; the IAEA works with Member States to establish analytical infrastructures to identify harmful pollutants.[148]

Nuclear technology can also be used to detect particular types of algae which cause 'red tides' that are harmful to marine species as well as the human populations. These harmful algae blooms (HABs) not only have a negative

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[139] Toshio Konishi. "Global Water Issues and Nuclear Seawater Desalination". World Nuclear University Summer Institute. http://www.jaif.or.jp/ja/wnu_si_intro/document/2010/t_konishi-global_water_issues_and_nuclear_desalination_(wnu_si2010).pdf
[140] "Nuclear Desalination." World Nuclear Association. http://www.world-nuclear.org/info/inf71.html
[141] Ibid.
[142] Ibid.
[143] Toshio Konishi. "Global Water Issues and Nuclear Seawater Desalination". World Nuclear University Summer Institute. http://www.jaif.or.jp/ja/wnu_si_intro/document/2010/t_konishi-global_water_issues_and_nuclear_desalination_(wnu_si2010).pdf
[144] "Nuclear Desalination." The International Atomic Energy Agency. http://www.iaea.org/NuclearPower/Desalination/ .
[145] Ibid.
[146] Ibid.
[147] *Nuclear Technology for a Sustainable Future.* IAEA. http://www.iaea.org/Publications/Booklets/NuclearTechnology/rio0612.pdf
[148] "Nuclear Desalination." The International Atomic Energy Agency. http://www.iaea.org/NuclearPower/Desalination/ .

impact on local marine wildlife but furthermore cause detriment to local and international fishing trades.[149] The IAEA has recently worked to implement 'red tide' algae early warning systems which utilize nuclear technology to monitor levels of harmful algae blooms. The IAEA has also worked with Member States to establish fourteen marine laboratories in Africa, Asia, Central and Latin America.[150] Samples are taken from monitoring stations located in fishing parks and analyzed the marine laboratories with the assistance of the IAEA. Isotopes are used to measure levels of HAB and this data is reported to local fisherman and consumers as to the potential harmful toxins to fishing practices. The laboratories are indicative of successful cooperation benefiting sustainable water management and local economies between Member States and the IAEA.[151]

Conclusion

As demand for water grows, it is imperative that the world fully understand the importance of clean water to the sustaining life at every level. The IAEA strives to apply nuclear technology to water resource management through many projects and programs. However, there still lies a significant gap across all forms of technology application, including isotope hydrology to track water flow and source, crop production, marine life salvation and groundwater contamination. These significant gaps include the unavailability in technology and education as well as a lack of technology sharing among Member States. The IAEA has placed an importance on sustainable development through water resource management via the Water Resources Programme and the various projects implemented by this programme. The IAEA recognizes that the individual projects of the WRP are very small in comparison; a more widespread approach is needed in order to close the gap in water availability as global demand continues to rise, potentially surpassing the capability of the IAEA and UN Subsidiary partners.

Committee Directive

Recently, the IAEA has asked the global community to consider whether national governments are making sustainable development a priority in policy framework.[152] The IAEA has also encouraged Member States to examine how water resource management is being integrated into sustainable development policies and frameworks. Member States have also been asked to consider how international cooperation could make a difference in the strive for sustainable development.[153] Delegates should take these initiatives and questions directly from the IAEA and work to analyze not only their own country's policies in regards to sustainable development and specifically to water resource management, but also to analyze what they can do to integrate more within the international community. Delegates should analyze gaps in mass implementation of resource management programs and specifically what the IAEA can do to further expand access to clean water to all citizens of the global community. It is important to not only analyze what those gaps are but to also identify what steps should be taken to further the work of the IAEA in the way of technology development and sharing, knowledge sharing, and implementation strategies. Delegates should consider partnerships with other organizations as well as within the UN in order to close these gaps and continue the work for closing the gap between supply and demand of clean water.

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[149] Ibid.

[150] Sasha Henriques. Protection from a Toxic Menace. IAEA Bulletin 53-1. September 2011. http://www.iaea.org/Publications/Magazines/Bulletin/Bull531/index.html

[151] Ibid.

[152] "International Atomic Energy Agency." RIO +20 United Nations Conference on Sustainable Development. http://www.uncsd2012.org/index.php?page=view&type=12&nr=83&respondent=55&menu=21&group=1

[153] Ibid.

III: Examining the use of Nuclear Energy as a Viable Alternative to Natural Resources

"It is time for a sustainable energy policy which puts consumers, the environment, human health, and peace first." -- Dennis Kucinich[154]

Introduction

It is no secret that, from the largest to the smallest, every Member State uses energy—and the bigger the state, the larger the demand. Thus, as the global population continues to grow, the demand for energy continues to rise, partly due to industrialized Member States which are already consuming large amounts of energy, but also due to emerging Member States which are experiencing unprecedented economic growth.[155] Currently, 85% of the world's energy is provided by fossil fuels such as coal, oil and gas.[156] Unfortunately, these fossil fuels are note easily replenished and it is estimated that they will be completely depleted by 2100.[157] Moreover, in burning fossil fuels, we inject 23 billion tons of carbon dioxide every year into the atmosphere – 730 tons per second.[158] While half of this carbon dioxide is absorbed in the seas and vegetation, the other half remains in the atmosphere where it is significantly altering the composition of the atmosphere and seriously affecting the climate of our planet.[159] As developed Member States try to break the addiction to fossil fuels due to rapidly diminishing supplies and rapidly rising costs, and developing Member States search for additional ways to independently satisfy their growing energy demand, the need for new sustainable energy options is becoming increasingly urgent. Of particular concern is "baseload electricity," which is the continuous, round-the-clock power required to power homes, businesses, schools, hospitals, military, communication networks, emergency services, and transportation systems.[160] Baseload electricity is a key component to economic growth, national security, and quality of life for all Member States and it is increasing significantly. In the U.S. alone, demand for electricity is expected to increase by 40% over the next 25 years.[161] At the same time, however, Member States are facing demands to limit emissions—the rapid growth in baseload electricity combined with the need to reduce emissions will make it impossible to meet future energy demand with traditional fossil fuel power plants. Despite the contributions of renewable energy sources like wind and solar, the current reality is that only nuclear power can provide large amounts of emissions-free, baseload electricity.[162]

Many countries are turning to nuclear energy as the solution to the energy problem, with many proponents hailing it as a sustainable alternative energy, in that nuclear energy is able to produce CO_2-free or 'zero emission' energy that is available in large quantities, stable in terms of safety and security, and economically competitive.[163] Advocates argue that nuclear power is clean, safe, reliable, compact, competitive and practically inexhaustible. However, those opposed to the use of nuclear energy argue that, due to the amount of waste it creates and the environmental toxicity and health dangers associated with that waste, nuclear energy is not sustainable at all.

Nuclear Energy: An Overview

Nuclear energy is created through one of two processes: nuclear fission and nuclear fusion. Nuclear fission, the more common process, consists of a deliberate, man-made nuclear reaction in which the nucleus of an atom is broken apart and the resulting heat/energy produced captured for consumption.[164] This process is unlike traditional

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154 Quotes on Alternative Energy. Notable Quotes. http://www.notable-quotes.com/a/alternative_energy_quotes.html
155 Francois Diaz Maurin. *Tentative Ideas to Explore the Viability of the Nuclear Option.* http://uab.academia.edu/Fran%C3%A7oisDiazMaurin/Papers/847939/Tentative_Ideas_to_Explore_the_Viability_of_the_Nuclear_Option
156 Ibid.
157 Ibid.
158 Ibid.
159 Ibid.
160 Ibid.
161 Ibid.
162 "Nuclear Energy – The Basics." All About Popular Issues. http://www.allaboutpopularissues.org/nuclear-energy.htm.
163 Ibid.
164 "Science Reference." Science Daily. http://www.sciencedaily.com/articles/n/nuclear_fission.htm

power plants which produce heat by burning gas, oil or coal.[165] Today; over 400 nuclear reactors provide base-load electric power in 30 countries,[166] and accounts for 16% of the total electricity in the world. [167]

Involvement of the IAEA with Nuclear Power as an Energy Source

Since its onset, the development of nuclear energy in all of its facets has been truly international, emerging from widely scattered research laboratories, as the ideas and work of scientists in one Member State stimulated and fertilized the minds of their colleagues in others.[168] Since almost the inception of the IAEA, one of its main aims has been to encourage the development of smaller nuclear power reactors suitable for use in developing countries. Initially, however, 'small' reactors were considered to be those generating up to 50 Megawatts (MW), which could allow for a large supply of energy for developing Member States in a facility small enough for a developing state to easily maintain.[169] This size reactor was quickly surpassed by developed Member States, which were already beginning to build reactors two or three times that size.[170] The search for what to classify as a 'small' or even 'medium' sized reactor would continue for decades, and the definitions of 'small' and 'medium' would continue to grow as well.

In September 1958, the second session of the IAEA General Conference specifically asked the Secretariat to study the power requirements of developing Member States as well as the benefits and costs of building small reactors in these countries and assisting in the training of personnel. By the end of 1959, 20 Member States had asked the IAEA for to advisement on the possible use of nuclear power.[171]

In 1958, the IAEA began administering the exchange of nuclear materials, pursuant to Article IX of its statute[172] The Though the IAEA would serve nominally as the supplier, with the materials actually being transported directly between Member States. In 1961–1963, the IAEA Secretariat also began its initial studies for developing nuclear power projects in the Philippines (for which a feasibility study was subsequently approved by the United Nations Special Fund), in the territory formally known as Yugoslavia, Pakistan, the Republic of Korea and Thailand.[173]

This set in motion the development of IAEA procedures for approving projects, and setting safeguards.[174] Initially, few developing Member States, many of which were, members of the G-77 showed interest in creating safeguards for nuclear power facilities, and some Member States were openly hostile to the idea.[175] However, on June 19, 1968, the IAEA adopted the *Treaty on the Non-Proliferation of Nuclear Weapons,* (also known as the *Non-Proliferation Treaty* or NPT), which entered into force in 1970 with the purpose of constructing a safeguards system to cover the entire nuclear fuel cycles of states not possessing nuclear weapons. By the beginning of the 1980s, almost all developed and many developing nations had joined the NPT, and, with the exception of those States possessing nuclear weapon, must signatories had agreed to place their nuclear material under IAEA safeguards, pursuant to Article III of the NPT.[176]

In recent decades, economic competitiveness has increased, which led to the IAEA making advances in strengthening the safeguards system such as requiring NPT Member States to provide information about and allow IAEA inspector access to all parts of a State's nuclear program, from uranium mines to nuclear waste and any other

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165 "Nuclear Energy – The Basics." All About Popular Issues. http://www.allaboutpopularissues.org/nuclear-energy.htm.
166 Ibid.
167 Ibid.
168 "History of the IAEA" The International Atomic Energy Agency. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf.
169 "History of the IAEA" The International Atomic Energy Agency. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1032_web.pdf.
170 Ibid.
171 Ibid.
172 Ibid.
173 Ibid.
174 Ibid.
175 Ibid.
176 *Nuclear Safeguards: The First Steps*. The International Atomic Energy Agency. http://www.iaea.org/Publications/Magazines/Bulletin/Bull491/49103480711.pdf

location where nuclear material intended for non-nuclear use is present.[177] These advancements allow the IAEA to ensure that nuclear materials are only being used for energy purposes.

Nuclear Energy Safety Concerns

Nuclear safety is one of the greatest concerns in developing nuclear energy programming. Nuclear safety refers to the safe management of nuclear power facilities to ensure that radioactive material is contained and that the surrounding environment and population are protected. Since the creation of nuclear power, there have been several breakdowns in nuclear safety which have highlighted the dangers of nuclear power. In May 1986, the Chernobyl nuclear facility suffered a power spike which ruptured the cooling tubes and caused an explosion as the water contacted the hot graphite in the core, and graphite fire.[178] The disaster caused the deaths of 42 emergency workers from radiation illness, radioactive exposure to 600,000 civilian and military persons, and the radioactive contamination of a 1,865 square mile area which resulted in a long-term evacuation.[179] In Middletown, Pennsylvania in the United States, the Three Mile Island nuclear facility suffered a nuclear "meltdown" in 1979.[180] In each of these two incidents, much of the cause was due to a lack of understanding on the part of the facility by the operators regarding what was happening.[181] Most recently, in 2011, The Dai-ici nuclear facility in Fukushima, Japan experienced a complete meltdown in the wake of a 9.0 magnitude earthquake and tsunami.

Waste Disposal and Effects on Environmental and Health Standards

Another major concern raised by opponents of nuclear power development is the resulting nuclear waste. In order to generate energy, fuel has to be spent in some way; all of which produce wastes. Fossil fuel combustion (FCC) wastes are produced from the burning of those fossil fuels (coal, oil, natural gas), and produce ash, slag and particulates from flue gas.[182] Nuclear wastes are produced through the cleaning of the reactors, and are filtered out of the air and water used to clean different types of reactors, but is never directly released into the environment from production.[183] FCC wastes are disposed of in many ways: dumping in landfills, dumping in oceans, storage in underground caverns, incineration, and deep-well injection; and these ways when properly carried out are designed to prevent further degradation of the environment and to protect humans and natural resources from dangerous exposure and contamination.[184] The disposal of nuclear waste, however, is often said to be the Achilles' heel of the industry by opponents of the energy source. In many countries, spent fuel is reprocessed to separate out the 3% of radioactive fission products and heavy elements to be vitrified, or cast in glass, for safe and permanent storage. The remaining 97% – plutonium and uranium – is recovered and recycled into new fuel elements to produce more energy.[185]

Advocates of nuclear power note that the volume of nuclear waste produced is very small compared to other industrial waste; according to some studies, a typical family's use of nuclear energy over a whole lifetime would produce vitrified waste the size of a golf ball.[186] Furthermore, radioactive waste comprises less than 1% of total industrial toxic waste, much of which remains hazardous indefinitely. Advocates point out that, it is the title "nuclear waste," that makes this waste sound so off-putting compared to waste from traditional energy sources.[187]

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[177] *IAEA Safeguards* The International Atomic Energy Agency. http://www.iaea.org/Publications/Booklets/Safeguards3/safeguards0707.pdf

[178] Frank von Hippel. *The Uncertain Future of Nuclear Energy*. The International Panel of Fissile Materials. http://fissilematerials.org/ipfm/site_down/rr09.pdf. 2010.

[179] Ibid.

[180] Backgrounder on the Three Mile Island Accident". United States Nuclear Regulatory Commission. http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html

[181] Ibid.

[182] "Fossil Fuel Combustion" United States Environmental Protection Agency. http://www.epa.gov/osw/nonhaz/industrial/special/fossil/index.htm

[183] "Waste, radioactive, from nuclear power plants." European Nuclear Society: http://www.euronuclear.org/info/encyclopedia/w/waste-radioactive-nnp.htm

[184] "Threats to Biodiversity." Discovery. http://curiosity.discovery.com/question/how-are-industrial-wastes-disposed

[185] Bruno Comby. *The Benefits of Nuclear Energy* http://www.ecolo.org/documents/documents_in_english/BENEFITS-of-NUCLEAR.pdf

[186] Ibid.

[187] "Radioactive Waste Management." World Nuclear Association. http://www.world-nuclear.org/info/inf04.html

In actuality, however, a report from the Oak Ridge National Laboratory shows that coal power actually results in more radioactive materials being released into the environment than nuclear power operation, the equivalency being 100 times as much radiation from coal plants as from ideal operation of nuclear plants.[188] This is due to the fact that coal ash is released directly into the environment, while nuclear plants use shielding to protect the environment from all of the radioactive elements in producing nuclear energy.

Opponents note, however that even miniscule amounts of radioactive waste products from the nuclear industry must be isolated from contact with people for very long time periods. The bulk of the radioactivity is contained in the spent fuel, which is quite small in volume.[189] This "high level waste" is converted to a rock-like form and emplaced in the natural habitat of rocks, deep underground.[190] While waste is the main hurdle for proponents of nuclear energy, there are current management methods that make issues with waste a much smaller issue. Large scale reprocessing is currently conducted in Britain, France and Russia, and is soon to start in China and India, as well as being done on an expanding scale in Japan.[191] Reprocessing is a series of chemical operations that separates plutonium and uranium from other nuclear waste contained in the used fuel from nuclear power reactors. The separated plutonium can be used to fuel reactors, but also to make nuclear weapons.[192] Reprocessing diminishes the volume of nuclear wastes substantially, but does not diminish the need for storage of the wastes that cannot be reused or salvaged for any beneficiary purposes. The method requires breeder reactors which are not yet commercially available and the lack of these breeder reactors stunt reprocessing from its full potential. France is currently the most successful re-processor, but it currently only recycles 28% of its yearly fuel use by mass. Radioactive wastes are very small relative to wastes produced by fossil fuel electricity generation, and used nuclear fuel may be treated as a resource as well as a waste.[193] Safe methods for the final disposal of high-level radioactive waste are technically proven; the international consensus is that this should be geological disposal.[194] Safety issues arise due to the harmfulness of the wastes produced; they must be removed from contact with the population for long periods of time before they pose no threats. In the vein of radioactive wastes, there are four categories that wastes fall into, all of which have their own requirements and regulations as to their safe disposal.

Exempt waste and very low level waste (VLLW) contain radioactive materials at a level which is generally not considered to be harmful to people or the surrounding environment. It consists mainly of demolished material (such as concrete, plaster, bricks, metal, valves, piping *etc*) produced during rehabilitation or dismantling operations on nuclear industrial sites.[195] The waste is therefore disposed of with domestic refuse, although countries such as France are currently developing facilities to store VLLW in specifically designed VLLW disposal facilities.[196]Low-level waste (LLW) is generated from hospitals and industry, as well as the nuclear fuel cycle. It comprises paper, rags, tools, clothing, filters *etc*, which contain small amounts of mostly short-lived radioactivity.[197] It does not require shielding during handling and transport and is suitable for shallow land burial. To reduce its volume, it is often compacted or incinerated before disposal. It comprises some 90% of the volume but only 1% of the radioactivity of all radioactive waste.[198]

Intermediate-level waste (ILW) contains higher amounts of radioactivity and some requires shielding. It typically comprises resins, chemical sludges and metal fuel cladding, as well as contaminated materials from reactor decommissioning.[199] Smaller items and any non-solids may be solidified in concrete or bitumen for disposal. It

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[188] Alex Gabbard. "Coal Combustion: Nuclear Resource or Danger." http://www.ornl.gov/info/ornlreview/rev26-34/text/colmain.html
[189] "Radioactive Waste Management." World Nuclear Association. http://www.world-nuclear.org/info/inf04.html
[190] Ibid.
[191] "Nuclear Wasteland" Ieee Spectrum. http://spectrum.ieee.org/energy/nuclear/nuclear-wasteland
[192] "Nuclear Power Risk." Union of Concerned Scientists. http://www.ucsusa.org/nuclear_power/nuclear_power_risk/nuclear_proliferation_and_terrorism/nuclear-reprocessing.html
[193] Ibid.
[194] Frank von Hippel. *The Uncertain Future of Nuclear Energy*. The International Panel of Fissile Materials. http://fissilematerials.org/ipfm/site_down/rr09.pdf. 2010.
[195] Ibid.
[196] Ibid.
[197] Ibid.
[198] Ibid.
[199] Ibid.

makes up some 7% of the volume and has 4% of the radioactivity of all radwaste.[200] High-level waste (HLW) arises from the 'burning' of uranium fuel in a nuclear reactor. HLW contains the fission products and transuranic elements generated in the reactor core. It is highly radioactive and hot, so requires cooling and shielding.[201] It can be considered as the 'ash' from 'burning' uranium. HLW accounts for over 95% of the total radioactivity produced in the process of electricity generation.[202] There are two distinct kinds of HLW: used fuel itself and separated waste from reprocessing used fuel as aforementioned in this guide. HLW has both long-lived and short-lived components, depending on the length of time it will take for the radioactivity of particular radionuclides to decrease to levels that are considered no longer hazardous for people and the surrounding environment.[203] If generally short-lived fission products can be separated from long-lived actinides, this distinction becomes important in management and disposal of HLW.[204]

Despite the advances in nuclear waste disposal, much of the opposition to nuclear energy still stems from the concerns of many nations as to waste management. The reality is that many current methods of disposal that are already proven to work are not actually put into practice in many Member States. The biggest gap lies with the most beneficial method of disposal, reprocessing, due to the fact that the recycled waste can be used not only to fuel reactors further, but to create nuclear weapons. Fear of nuclear proliferation is a major deterrent from reprocessing, and consequently complicates the argument for a shift to a more long-term sustainable energy source than that of fossil fuels.

Access of Energy to Individuals, Industries & the State

Nuclear energy brings several advantages to the table for the energy debate. Firstly, unlike oil, two of the three largest producers are Australia and Canada, both of which have stable governments and represent reliable sources of supply.[205] This is important because the stability of the governments of nations controlling an energy source is a large factor in the stability of world prices; much like the disruption in the Middle East during the last four decades raised world oil prices during each moment of instability.[206] Second, once reactors are built, they are cost efficient to maintain them, even at high capacity. They are therefore useful in addressing demand fluctuations as countries cut back on usage of fossil fuels.[207] Finally, nuclear plants tend to remain in operation for long periods of time, and many existing plants have become more efficient over time, reducing their demand for uranium.[208]

However, Nuclear energy has its disadvantages compared to energy via natural resources, such as: safety issues with nuclear wastes and potential terrorist attacks on nuclear power plants, economic concerns (i.e. construction costs, government taxes on plants), and availability of uranium.[209] Since 2000, construction costs and productions costs have risen substantially, due in large part to the increase in demand for energy. The availability of uranium is a true accessibility issue, as current reserves only contain about enough for 85 years of consumption at current rates.[210] However advanced technologies are being developed which are far more efficient in their use of Uranium or which utilize Thorium which is 3 times more abundant than Uranium. If perfected these technologies can make use of both the spent fuel from current nuclear reactors and the depleted Uranium stocks used for enrichment, which taken together these provide enough fuel for many thousands of years of energy production. This will mitigate the demand for newly mined Uranium.[211]

[200] Ibid.
[201] Ibid.
[202] Ibid.
[203] Ibid.
[204] Ibid.
[205] Ibid.
[206] Richard N. Cooper. *World Trade, the Middle East, and the Stability of World Oil Supplies.* The World Economy. Volume 21 Issue 4 pgs 471-481.
[207] Ibid.
[208] Ibid.
[209] "Identifying the Opportunities in Alternative Energy." Wells Fargo Corporation. https://www.wellsfargo.com/downloads/pdf/about/csr/alt_energy.pdf
[210] "Availability of Useable Uranium." Nuclearinfo.net. http://nuclearinfo.net/Nuclearpower/WebHomeAvailabilityOfUsableUranium
[211] Ibid

For developed Member States, a shift towards nuclear power would start to break down the dependency on fossil fuels that has grown over the last several centuries, as well as lessening the pollution of our world by the densely populated industrial nations that use the majority of the world's energy and natural resources. To achieve economic development and industrial progress, an increased supply of energy and of electricity is of vital importance, and for this, nuclear power constitutes a viable alternative energy source.[212]Developing countries, in comparison with industrialized countries, generally have higher growth rates of population, energy, and electricity and therefore need energy source to accompany this rapid growth. There are currently also striking disparities of total and per capita energy and electricity consumption. The IAEA has a long-standing reputation for providing advice and technical assistance to developing Member States seeking to launch a nuclear power program. This promotional effort has been part of the Agency's activities since its inception in 1957 and has been accomplished through all available means. These include advisory missions, training courses and study tours, fellowships, guidebooks, meetings, maintenance of data banks, provision of opportunities and channels for worldwide information and data exchange, and the development of planning tools, such as the Model for Analysis of Energy Demand (MAED) and Wien (Vienna) Automatic System Planning (WASP).[213]

Although the cost of energy produced by existing nuclear plants is competitive, the upfront capital costs of constructing new plants are extremely high, calculated at $1,300-$1,500 per kilowatt- hour, or twice the amount it costs to construct a gas-fired power station.[214] Given the long life of nuclear power stations, however, supporters argue that the upfront costs, at least, are justified.[215] However, nuclear energy provides states with a long-term, cost-efficient, large scale alternative to fossil fuels, by providing an energy source that can be produced and controlled with relative ease.[216] Though it is a viable alternative energy source and assistance is available, Nuclear power poses specific demands on national infrastructures that have to be satisfied by any country to achieve success in its introduction and its safe and reliable use.[217] These demands include nuclear power's technical complexity, the required high level of investment, and strict safety requirements. They are especially relevant to developing countries, where a lack of resources or capabilities to meet requirements may constitute the principal constraints to the development of a nuclear power program.[218] Problems facing a developing country in the introduction of nuclear power are not insurmountable, as shown by the experience of those developing countries that have already done so, such as Taiwan and much of Latin America. However, the effort required to strengthen or to build up national infrastructures and capabilities to necessary levels may exceed available national resources, or they may not be compensated for, or justified, by nuclear power's expected benefits

Conclusion: What is to be done?

The largest concerns with moving toward nuclear energy stem largely from questions about safety. Most of those questions have to do with disposal of wastes, as this is the largest drawback for most individuals. On the other side of the coin, however, nuclear energy is still too unsafe and risky to depend on for large-scale energy needs for some people.

For many, nuclear power now represents the future of our energy needs on a global scale, as it is the most long-term cost-efficient alternative energy source by many measurements. China, for instance, already has one of the most ambiguous programs in the world with plans to have over 70 GW (5%) of installed capacity by 2020, and a further increase to more than 200 GW (16%) by 2030.[219] The debate on nuclear energy is large and spirited, and essential to solving the question of what to do for the quickly vanishing natural resources we depend on for our energy needs.

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[212] *Nuclear Power in Developing Countries: Requirements and Constraints*. International Atomic Energy Agency. http://www.iaea.org/Publications/Magazines/Bulletin/Bull292/29204783942.pdf

[213] Ibid

[214] Ibid.

[215] Ibid.

[216] Ibid.

[217] Ibid.

[218] *Nuclear Power in Developing Countries: Requirements and Constraints*. International Atomic Energy Agency. http://www.iaea.org/Publications/Magazines/Bulletin/Bull292/29204783942.pdf

[219] "China Ups Targeted Nuclear Power Share From 4% to 5% for 2020." Window of China. http://news.xinhuanet.com/english/2008-08/05/content_8967806.htm.

Committee Directive

Delegates should take their time when preparing for debate on this topic at the conference. We want delegates to come ready with more than the notion of whether nuclear energy is good or bad. What could this technology do for your Member State? Is nuclear energy truly a viable alternative energy for you? The IAEA aids developing Member States in starting their nuclear programs, but is this the correct route? Does nuclear energy provide sufficient benefits to outweigh the concerns for safety and waste disposal? What about the environment? What safeguards and plan implementations would have to be introduced for nuclear energy to work as a viable alternative to the non-renewable and quickly depleting natural resources? What types of additional restrictions or regulations should be placed upon States in regards to nuclear development? How can we ensure that every Member State with nuclear aspirations use the technology for the correct purpose? Delegates should consider their own country's experience with nuclear energy and assess its benefits and detriments on a national scale. If we are ever going to be able to have a meaningful conversation about using nuclear energy as a viable alternative to natural resources, delegates must have a working understanding of all aspects of the topic and be ready to work together on meaningful resolutions for this difficult debate.

Technical Appendix Guide (TAG)

Topic I: One Year After Fukushima: Evaluating Improvements in Technological Safeguards to Protect the Global Population during a Disaster

"About Us." World Association of Nuclear Operators. http://www.wano.info/

Established in 1989, shortly after the Chernobyl incident of 1986, WANO is a non-profit organization operating at the global level to coordinate the exchange of information between all 440 operating nuclear reactor facilities. They are not a regulatory authority like the IAEA, but offer their services primarily through peer-review assessments, that help to strengthen an NPPs established safety standards. On March 31, 2011, WANO established its Post-Fukushima Commission to determine lessons to be learned from the event. In October, 2011, began implementing methods to achieve: expanding the scope of WANO activities, develop a worldwide integrated event response strategy, improve its own credibility in its peer reviews, improve visibility, and improve the quality of all its services. WANO works to assist the nuclear energy community with four programmes: peer-reviews, operating experiences, technical support & exchange, and professional and technical development services.

Cooper, Mark. "Safety Management in the Emergency Response Services." *Risk Management*. 2000.
http://www.jstor.org/stable/3867856?origin=JSTOR-pdf

Where this article brings a focus to emergency response services in the field of Occupational Health and Safety (OHS), lessons learned and recommendations made are clearly applicable to the topic at hand. Cooper marks distinguishing features in the management styles of major hazard industries. Secondly, he notes research completed by an Advisory Committee on the Safety of Nuclear Installations (ACSNI) which identifies the importance of "safety culture". In tying this TAG article to the topic, lessons learned from Fukushima will bring about change. Cooper defines how and where these "factor promoting change" will occur through: legislation, incurred fatalities, civil litigation, and operational training. Change through these factors will improve current safety standards on the individual State and international level.

Davis, Lucas W.. "Prospects for Nuclear Power." *The Journal of Economic Perspectives*. Winter 2012.
http://www.jstor.org/stable/41348806?origin=JSTOR-pdf

While implementing an NPP, a variety of hurdles must be overcome before the facility itself becomes fully operational. Davis addresses financing the construction of a nuclear power plant facility as THE major hurdle facing States wishing to pursue nuclear energy, especially in the context of the 2008 Global Recession.

Furthermore, it addresses the enthusiasm Member States had for increasing their nuclear power plant numbers, right up until the 2011 Fukushima Disaster. Delegates reading this article should take away from it Davis's emphasis on the fact that failure to implement safety standards results in unapproved safety assessments, which prolong the building and thus involves added financial costs, in the construction and operation of a nuclear facility.

Ferguson, Charles D.. "Think Again: Nuclear Power." *Foreign Policy*. November 2011. http://www.foreignpolicy.com/articles/2011/10/11/think_again_nuclear_power?page=0,4

Ferguson provides us a more in-depth analysis about the future of States pursuing the nuclear power option. He focuses on a number of aspects, using the events from Fukushima as a backdrop, citing the need to overhaul IAEA Nuclear Safety Standards, to greatly improving the oversight and transparency of a nuclear facilities managers and operators. This article also goes into brief detail to dispel a number of misconceptions associated with nuclear energy: that entering into nuclear energy programs will help a State alleviate its poverty, also that dealing with nuclear waste is an NPPs biggest drawback.

Fukuda, Nobuo. "Japan's Nuclear Cabal." *Foreign Policy*. March 9, 2012. http://www.foreignpolicy.com/articles/2012/03/09/japan_tsunami_anniversary?page=0,3

This article serves as an excellent introduction into some of the current issues facing Japan and its nuclear energy programme. One year after the disaster at Fukushima, Japan, the Nation itself is at a critical juncture that will determine the fate of its current usage of nuclear energy. The questionability of the safety of nuclear programmes has had far reaching impacts, domestically and abroad. The biggest issue is how Japan will put to rest the public's concerns of continued reliance on nuclear power plants. Prior to the Fukushima incident, plans for an additional 14 nuclear reactors had already been approved. However the majority of these have been shelved. How the IAEA, working in conjunction with the international community to improve Nuclear Safety, will be critical in restoring public confidence in the use of such technology.

Ion, Sue. "Nuclear Energy: Current Situation and Prospects to 2020." *Philosophical Transactions: Mathematical, Physical and Engineering Sciences*. April, 2007. http://www.jstor.org/stable/25190480?origin=JSTOR-pdf

Ion's standardization of nuclear power plant facility designs, to coincide with already established IAEA Safety Standards, is the thesis of this article. Using the United Kingdom as a backdrop, it shows the need to change the current thinking of the "design as you go" approach, which can result in delays in the overall approval processes. The timing couldn't be more perfect, as the UK, and other States around the world, will need to begin the Decommissioning process of retired nuclear facilities in lieu for new ones.

Kim, Duyeon, and Jungmin Kang. "Where Nuclear Safety And Security Meet." *Bulletin of The Atomic Scientists*. 2012. http://thebulletin.sagepub.com

In light of the Fukushima disaster is an interesting take on the future of nuclear safety by combining it with various aspects of nuclear security, which would result in a so called nuclear safety-security interface. This article presents us the shifting paradigms of thought influencing the research and implementation of nuclear safety standards: from the Three-mile Island event (showing weaknesses in defense-in-depth), Chernobyl (the need for a safety culture), and Fukushima (to include the possibility that defense-in-depth measures could be exceeded). In the event terrorist groups might take advantage of a nuclear facility currently under duress by a natural event, they would have no problems creating further damage to a facility, as they lack adequate security measures. According to these researchers, there is much overlap between NA and NS so that this new nuclear safety-security interface that would: combine defense-in-depth strategies (safety) with systems designed to prevent potential sabotage (security). This overlap would also include an improvement by interfacing facility mechanisms as recommended by "postulated accidents" (safety) with an integrated mixture of installed hardware, procedures, and facility security systems (security). Key areas for improvement would be: securing off-site electrical supplies, protecting the reactor cooling system, and guarding the main control room.

Qiang, Wang & Xi Chen. "Regulatory Failures for Nuclear Security-The Bad Example of Japan-Implication for the Rest of the World." *Renewable and Sustainable Energy Reviews*. March, 2012. www.elsevier.com/locate/rser

One year later, reviews of the incident lead to a number of accepted theories as to why the Fukushima nuclear accident of 2011 was such a catastrophe. The focus of this article seeks to narrow the blame solely onto nuclear regulatory failures. Three main concepts are highlighted, and their actions defined within the context of Japan: the control of corruption, the regulatory captive, and abiding by rules of law. An interesting correlation is made between the corruption of Japans nuclear safety regulation system and Japans economic system. As a result, regulatory agencies become dominated by the industries regulated. For example, Japans Nuclear and Industrial Safety Agency (NISA) placed profiteering over maintain an adequate supply of full-time technical experts. Furthermore, the author offers a short comparison to both the United States of America, and the People's Republic of China. The US does a better job overall, splitting nuclear energy responsibilities between two agencies: the Department of Energy, and the Nuclear Regulatory Commission. Whereas China lacks any specific atomic energy law, and has yet to establish an efficient nuclear energy administration. Japan has a very well-conceived (and comprehensive) legislative framework for regulating nuclear safety, the rule of law is not being enforced and this needs to be rectified.

Suzuki, Tatsujiro. "Deconstructing The Zero-Risk Mindset: The Lessons And Future Responsibilities For A Post-Fukushima Nuclear Japan." *Bulletin of The Atomic Scientists*. 2011. http://thebulletin.sagepub.com

Suzuki presents us a well-rounded article post-Fukushima, further highlighting areas for improvement regarding aspects of nuclear safety standards, and emergency preparedness and response. The author constantly emphasizes the need to do away with the "zero-risk" mindset, inferring that even the highest set of implemented safety standards will only lead to complacency. He offers a number of insights into where and how improvements to various aspects of NA and emergency preparation and responses should begin. Some of the areas he mentions center around restructuring the safety regulatory process, implementing thorough accident-management measures, enhancing emergency preparedness by a better mobilization of backup resources, and to ensure that there is a public communications system in place. He believes that by taking these ideas into account, a streamlined response system could be adopted at the national and IAEA levels of implementation.

Yoon, Won-Hyo. "The Role of Research in Nuclear Regulations: a Korean Perspective." *Nuclear Engineering and Design*. July, 1998. www.elsevier.com:locate:nucengdes

This article speaks volumes on behalf of the necessity for up-to-date nuclear regulations to coincide with advances in technology, so that the public opinion of pursuing nuclear energy are well into the positive majority. Since the inception of its NPP in the late 1970's, South Korea has had the most updated regulatory techniques in place, than other States in the Asia-Pacific region. Their government established three bodies to oversee and govern their NPP: a national level decision making body on nuclear safety, an independent regulatory authority with provisioned enforcement mechanisms, and a technical expert organization. As a result of their work to identify the best: nuclear regulatory technologies, practices for radiation safety and waste management, and implementation for nuclear regulation requirements, the government continues to emphasize that the highest level of safety is accomplished all throughout the design, construction, and operation of their NPP.

Topic II: Utilizing Nuclear Techniques in Water Resource Management to Expand Water Access to a Growing Population

Pradeep Aggarwal. *Innovative Technologies for Sound Decision-making in Water Resource Management*. The International Atomic Energy Agency. http://www.un.org/esa/sustdev/csd/csd16/LC/presentations/iaea.pdf

In this presentation Aggarwal, the Programme Manager for the Water Resources Program(WRP) of the IAEA, gives a simple look into how the IAEA is working with the WRP to implement nuclear technologies in the field of water resource management. The application of such technology and the chemical composition of the effects on water molecules as well as the application of isotope hydrology is discussed. This is a good place for delegates to begin to understand the basics of nuclear technology as it is applied to water resource management as well as isotope hydrology.

"Nuclear Technology for a Sustainable Future." The International Atomic Energy Agency. http://www.iaea.org/newscenter/news/2012/rio20.html.

This article outlines how the IAEA contributes to the key areas of focus of the Rio +20 Conference on Sustainable Development. This page also contains a link to the brochure distributed by the IAEA noting important work of The Agency in the realm of water resource management and sustainable development. It is important for delegates to understand the recent work of the IAEA in regards to the Rio +20 conference as well as the work towards sustainable development.

Introduction of Nuclear Desalination. The International Atomic Energy Agency. http://wwwpub.iaea.org/MTCD/publications/PDF/TRS400_scr.pdf.

Delegates can use this book published by the IAEA to understand the process as well as technical and economic considerations surrounding Nuclear Desalination. This report includes technical process of nuclear desalination along with the coupling of existing nuclear power plants with desalination technology. Economic considerations are also included discussing both the costs and benefits of implementing such technology. The publication is a summary of data captured in previous reports as well as provides information and guidance around decision making and implementation.

Advances in Isotope Hydrology and Its Role in Sustainable Water Resources Management. International Atomic Energy Agency. 2007.

Every four years, the IAEA holds a symposium on water resource management and discusses the advancement of nuclear techniques. The IAEA plays a strong role in isotope hydrology techniques and their application to water resource management in both developing and developed Member States. The result is this publication summarizing the discussions and advancements of isotope technology. Delegates can use this publication to understand the recent advancements in isotope techniques and how they can be implemented into existing and new programs to benefit developing Member States in an economically efficient manner.

Joel R. Gat. *Isotope Hydrology: A Study of the Water Cycle.* World Scientific. Feb 28, 2010.

This book introduces a fundamental understanding of isotope techniques, specifically isotope hydrology and its application within the water cycle. This book outlines the technology and science behind isotopes and give delegates an understanding of how isotopes interact with each step of the water cycle. The book also discusses how isotope hydrology can play a part in water resource management as climate change alters the water cycle and ultimately the way populations derive and use water.

"Water and the Environment: Success Stories." The International Atomic Energy Agency: Technical Cooperation. http://www.iaea.org/technicalcooperation/Pub/Suc-stories/Water-Env.html

This webpage highlights the work of the IAEA since 2007. Each publication documents a program of nuclear techniques applied to various areas of water resource management in Member States throughout the world. It is important for delegates to have knowledge of successful programs not only within their country but more importantly in other Member States. The understanding of a successful application in a Member State outside their own spurs knowledge and technology sharing which is essential to the IAEA mandate.

M.S. Rao, et al. *Potential Application of Nuclear Techniques in Water Resource Sector – A Status and Future Prospects.* National Institute of Hydrology, Roorkee. April 2012.

In consideration of India Water Week 2012 the National Institute of Hydrology outlines the need for greater water resource management due to rising global demands for clean, drinkable water. The paper then outlines isotope hydrology and recent advances within the field. This paper summarizes a number of case studies of isotope technology application to demonstrate the potential for improvement in sustainable water resource management specifically in India. Delegates can use this as an understanding of not only the work done within India but also as an inspiration to begin considering ways to advance technology and programs for a multitude of Member States.

Water Use and Nuclear Power Plants. Nuclear Energy Institute. May 2011. http://www.nei.org/resourcesandstats/documentlibrary/protectingtheenvironment/factsheet/water-use-and-nuclear-power-plants/.

This fact sheet gives an analysis of nuclear power plants versus conventional energy sources (fossil feuls) specifically in regards to water resource management. This document takes a holistic approach to the analysis of implementing a water resource management program utilizing nuclear technology. Delegates should use this source to begin to understand the types of questions that must be answered when making decisions around technology sharing and implementing nuclear programs.

Dr. Mir F Ali. *Chapter 21: Nuclear Energy: Applications – Sustainable Land and Water Management – Improving Agricultural Water Management.* February 2012. http://intuitech.biz/chapter-21-nuclear-energy-applications-sustainable-land-water-management-improving-agricultural-water-management-edited-dr-mir-f-ali/.

Dr Ali works to educate the reader not only of the basics of isotope technology application in regards to water resource management but furthers the discussion to focus on sustainability. In light of the recent Rio + 20 conference on Sustainable Development and the theme of SRMUN XXIII it is important for delegates to research sustainable solutions for water resource management beyond the programs currently implemented. Dr Ali also offers research and ideas around the future of isotope hydrology specifically in regards to agricultural water management. This is important in furthering multiple MDG's dealing with food scarcity and health improvement.

Greater Agronomic Water Use Efficiency in Wheat and Rice Using Carbon Isotope Discrimination. International Atomic Energy Agency. 2012. http://www-pub.iaea.org/books/iaeabooks/8559/Greater-Agronomic-Water-Use-Efficiency-in-Wheat-and-Rice-Using-Carbon-Isotope-Discrimination.

An essential function of the IAEA is to conduct research in accordance with Member States to advance technology and increase efficiency. This report outlines a research study performed by the IAEA using carbon isotope discrimination to increase agronomic water-use efficiency. Delegates can use this study to creatively incorporate newly advanced technology and techniques on a large scale to developing Member States as their need increases exponentially.

Topic III: Examining the Use of Nuclear Energy as a Viable Alternative to Natural Resources

Frank von Hippel. The Uncertain Future of Nuclear Energy. 2010. http://fissilematerials.org/ipfm/site_down/rr09.pdf.

This research report shows the depth of nuclear energy as well as many of the issues with it as an energy source for the long-term future. Hipple puts all of the issues on display and goes into each one of them in-depth, one by one. This source is immensely useful for delegates to see the amount of issues against nuclear energy, and this is important as to show delegates what obstacles there are to overcome in regards to the issue of nuclear power's sustainability.

The Future of Nuclear Power. Massachusetts Institute of Technology http://web.mit.edu/nuclearpower/.

This page for The Future of Nuclear Power made by MIT links to several great resources for delegates to grasp for their own usage; the main point of interest is the 2003 Full Report on nuclear energy and all of the available options for the future, and the 2009 update to the 2003 report. Both are richly deep with valuable information on nuclear energy and all of the possibilities it presents for the future. With over thirty pages of information, delegates will have a very useful source from MIT.

Jan Willem Storm van Leeuwen and Philip Smith. *Can Nuclear Power Provide Energy for the Future; Would it solve CO_2-emission problems?* 2002. http://greatchange.org/bb-thermochemical-nuclear_sustainability_rev.pdf

As the title of this document outlines, this source focuses on the greenhouse gasses our current energy sources produce against that from nuclear power. Leeuwen and Smith examine the true differences between the two energies, and are somewhat skeptical to stand behind nuclear energy. They debate upon the true sustainability of nuclear power, as well as its longevity as an energy source.

John McCarthy. "Frequently Asked Questions About Nuclear Energy." 2006 http://www-formal.stanford.edu/jmc/progress/nuclear-faq.html

A question-and-answer walk through of nuclear energy basics, this source details all the functions of the nuclear energy process and allows delegates to grasp a further understanding of those basic functions and their importance to nuclear energy and it's sustainability for the future. The information is in depth and broken down well to allow for those with little current knowledge, average knowledge, and advanced knowledge of nuclear energy alike to understand.

Joshua M. Pearce. "Limitations of Nuclear Power as a Sustainable Energy Source." 2012. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=20&ved=0CGkQFjAJOAo&url=http%3A%2F%2Fwww.mdpi.com%2F2071-1050%2F4%2F6%2F1173%2Fpdf&ei=V4wA UPDmKoGo8ASu19TxBw&usg=AFQjCNH4eOSw7vDQeTl2YW0W8Om_pKdmGw

Pearce here details all of the intricacies of nuclear power, and details some of the challenges proponents of nuclear energy must manage to overcome to truly be able to call nuclear power a sustainable energy source. His findings show that technical solutions need to be found for the environmental concerns of nuclear power as well as addressing the difficult issues of equity in both the present and future generations. Delegates can use this resource to understand the faults that are necessary to overcome in regards to the issue of nuclear power's sustainability.

Nuclear Energy Institute. http://www.nei.org/

The Nuclear Energy Institute's website is host to an array of useful information about protection of the environment, reliability and affordability of nuclear energy, safety and security, as well as waste disposal. The site has links to breaking news, policy updates, and resources/stats to provide further understanding of the basics of the nuclear energy debate for delegates.

Nuclear Energy: What Part of the Solution to Climate Change? OCED Forum 2008 http://www.oecd.org/dataoecd/23/44/40764069.pdf

While many of the documents outlined in both the background guide as well as the technical appendix guide are focused on the technicalities of nuclear power and the specifics within, this source focuses closely on the environmental stance of nuclear energy, looking at how nuclear energy can change or influence the effects of energy consumption, especially in the vein of climate changes from greenhouse gasses.

"Nuclear Power: A sustainable Source of Energy." American Nuclear Society. http://www2.ans.org/pi/brochures/pdfs/power.pdf

A pamphlet made by the American Nuclear Society, this resource has many poignant thoughts about waste disposal, land use, long-lasting reserves, environmental and personal safety, and more. The wealth of entry level knowledge on the subject of the sustainability of nuclear power in the pamphlet is immense, and will prove useful to all delegates.

"Nuclear Power Alternative to Fossil Fuels, IAEA Director Informs General Assembly." United Nations Information Service. http://www.unis.unvienna.org/unis/pressrels/2001/ga9938.html

A direct press release from the IAEA Director tells the General Assembly about nuclear energy as a new resource, as well as talking about the environmental consequences of burning the fossil fuels we currently depend upon so desperately. Within the press release, many things are brought to light, such as the availability of nuclear power already and the safety nuclear power. Delegates will find useful information about numerous issues within the nuclear power debate through this press release.

Sustainable Energy. World Nuclear Association (2011). http://www.world-nuclear.org/info/inf09.html

This source is very rich with information pertaining to supply sources and demand of nuclear energy, as well as that of safety and security. The site also has links to further information about nuclear energy and all it entails. This source can prove very useful for delegates trying to gain more understanding about nuclear energy.