NUCLEAR ENERGY

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Energy from disintegrating atomic nuclei has a tremendous potential to do good for the people of the world. We routinely use X-rays to examine for fractures, treat cancer with radiation and diagnose disease with the use or radioactive isotopes.

About 17% of the energy in the world comes from nuclear power plants.

Some facts about History of Nuclear Energy Development: the first controlled fission of an atom occurred in 1938 in Germany; the US was the first to develop an atomic bomb; in 1945, the US military dropped bombs on the Japanese cities of Hiroshima and Nagasaki; during the 50 years following WWII, the two major super powers conducted secret projects related to the building and testing bombs; a legacy of the military research is that a great deal of soil, water, and air are contaminated with radioactive material (Hanford, Savannah River sites).

After WWII many people began to see the potential for using nuclear energy for peaceful purposes. The world's first electricity generating reactor was constructed in the US in 1951.

In December 1953, President Dwight D. Eisenhower, in his "Atoms for Peace" speech said: "Nuclear reactors will produce electricity so cheaply that it will not be necessary to meter it. The user will pay an annual fee and use as much electricity as they want. Atoms will provide a safe, clean, and dependable source of electricity."

The Russians built their first plant in 1954.

Nuclear reactor construction in the US has been on hold for a long time now as concerns over the safety of the reactors and the problem of nuclear waste storage have not been solved. Nuclear power industry experts believe that the American public will begin to favor nuclear reactors as a source of electricity because they do not produce carbon dioxide during the production of electricity. The Bush energy plan has provisions for constructing nuclear reactors. Energy Policy Act – 1.45 billion plus for the cogeneration part – Subtitle D – Nuclear Energy 4.6 billion

Atomic structure – Atoms are fundamental subunits of matter. Matter is anything that takes up space and has mass. Air, water, trees, cement, and gold are examples of matter. All atoms have a central region known as the nucleus, which is composed of two kinds of relatively heavy particles: positively charged particles called protons and uncharged particles called neutrons. Surrounding the nucleus is a cloud of relatively light weight, fast moving, negatively charged particles called electrons. The atoms of each element differ in the number of protons, neutrons, and electrons present.

Isotopes – All atoms of the same element have the same number of protons and electrons but the number of neutrons may differ. Atoms of the same element that differ in the number of neutrons are called isotopes. Since the positively charged protons in the nucleus repel one another energy is needed to hold the protons and neutrons together. However, some isotopes of some atoms are radioactive, that is the nucleus of these atoms are unstable and decompose. Neutrons, electrons, and protons are released during this decomposition releasing a great deal of energy. Half-life ½ of radioactive material to decompose. Only certain kinds of atoms are suitable for the development of a nuclear chain reaction. The two materials most commonly used are uranium-235 and plutonium-239.

Nuclear Fuel Cycle. – To appreciate the consequences of using nuclear fuels to generate energy it is important to recognize the nuclear fuel cycle. Mining produces low grade uranium ore. The ore contains 0.2 % uranium by weight. After it is mined, the ore goes through a milling process. It is crushed and treated with a solvent to concentrate the uranium. Milling produces yellow-cake, a material containing 70-90% uranium oxide. Naturally occurring uranium ore contains about 99.3% no fissionable U-238 and only 0.7% fissionable U235 (the U235 is the uranium isotope needed in nuclear reactors). This concentration of U-235 is not high enough for most types of reactors, so the amount of U-235 must be increased by enrichment. Since the masses of the isotopes U-235 and U-238 vary only slightly, enrichment is a difficult and expensive process. However, enrichment increases the U-235 content from 0.7% to 3%.

Nuclear Reactors – A nuclear reactor is a device that permits a controlled fission chain reaction. In the reactor, neutrons are used to cause a controlled fission of heavy atoms such as Uranium 235 (U-235). U-235 is a uranium isotope used to fuel nuclear fission reactors.

Boiling-water reactor – The heat generated by the fission of or uranium releases energy that heats water to produce steam to turn turbines to generate electricity. In addition to fuel rods containing uranium, reactors contain control rods of cadmium, boron, graphite, or some other non-fissionable material used to control the rate fission by absorbing neutrons. Lowering the rods decreases the rate of reaction.

Pressurized-water reactor – The light water reactors (LWR) make up 90% of the reactors operating today, use ordinary water as the moderator and as the coolant. The BWR and PWR are light water reactors. In a BWR (20% of reactors in the world). Steam is formed within the reactor and transferred directly to the turbine. The steam must be treated and the generating building must be shielded. In the PWR (70% of reactors in the world) the water is kept under high pressure so that steam is not formed in the reactor. Such an arrangement reduces the risk of radiation in the steam but adds to the cost of construction by requiring a secondary loop for the steam generator.

The future of nuclear power is uncertain. The International Atomic Energy Agency (IAEA) forecasts that the total installed nuclear capacity in 2015 will be little more than that in 2000. In 2002, Germany announced that it would close all 19 of its nuclear power plants by 2021 making it the largest industrialized nation willing to forgo the technology. Most planned reactors are in the Asian region. Both South Korea and Japan have plans for new plants (South Korea, 12 reactors, Japan 15 reactors). China with four operating reactors, has begun the next phase of its nuclear power program. Construction has started on seven reactors. Most nuclear power plants originally had a nominal life span of 40 years, but engineering assessments of many plants over the last decade have established that many can operate longer. In the US most reactors now have confirmed life spans of 40 to 60 years. In Japan, 40 to 70 years. In the US the first two reactors have been granted license renewals, which extends their operating lives to 60 years. A few tidbits:

– No new plants commissioned in US since 1974;
– 17% of electricity from nuclear power plants;
– 103 plants currently operating at 64 sites in 31 states;
– nuclear power plants ran 92% of the time in 2002;
– average age is 22 years, programmed age 40 years extended to 60;
– Spent fuel at Texas's plants stored in water filled vats.

Since 1993, 175 metric tons of uranium from weapons have been transformed into fuel for nuclear power plants.

Nuclear Fusion – The energy that would be released by combining the deuterium in one cubic meter of ocean water would be greater than that contained in all of the world's entire fossil fuels. Even though in theory fusion promises to furnish large amounts of energy, technical difficulties appear to prevent its commercial use in the near future. Even the governments of nuclear nations are budgeting only modest amounts of money for fusion research. And, as with nuclear fission and the breeder reactor, economic costs and fear of accidents may continue to delay the development of fusion reactors. Chernobyl is a small city in Ukraine near the border with Belarus, north of Kiev. At 1 A.M. on April 25, 1986, at Chernobyl Nuclear Power Station-4, a test was begun to measure the amount of electricity that a still spinning turbine would produce if the steam were shut off. This was important information because the emergency core cooling system required energy for its operation and the coasting turbine could provide some of that energy until another source became available. But the test was delayed because of a demand for electricity, and a new shift of workers came on duty. The operators failed to program the computer to maintain power at 700 megawatts, and output dropped to 30 megawatts. This presented an immediate need to rapidly increase the power, and many of the control rods were withdrawn. Meanwhile, an inert gas (xenon) had accumulated on the fuel rods. The gas absorbed the neutrons and slowed the rate of power increase.

Decommissioning Costs – Decommissioning a fossil fuel plant is relatively easy a wrecking ball is about all that is required. Nuclear power plants are not demolished they are decommissioned. Decommissioning involves removing the fuel, cleaning the surfaces, and permanently preventing people from coming in contact with the contaminated buildings and equipment.

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WIRELESS POWER TRANSMISSION

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Introduction: Researchers have developed several techniques for moving electricity over long distances without wires. Some exist only as theories or prototypes, but others are already in use. This paper provides the techniques used for wireless power transmission.

Wireless Power Transmission System.

William C. Brown, the pioneer in wireless power transmission technology, has designed, developed a unit and demonstrated to show how power can be transferred through free space by microwaves. In the transmission side, the microwave power source generates microwave power and the out-