Outline History of Nuclear Energy

http://www.world-nuclear.org/info/Current-and-Future-Generation/Outline-History-of-Nuclear-Energy/

•The science of atomic radiation, atomic change and nuclear fission was developed from 1895 to 1945, much of it in the last six of those years.

•Over 1939-45, most development was focused on the atomic bomb.

•From 1945 attention was given to harnessing this energy in a controlled fashion for naval propulsion and for making electricity.

•Since 1956 the prime focus has been on the technological evolution of reliable nuclear power plants.

Before reading this article what do I know about nuclear energy?

I know that it involves the splitting of Uranium atoms. I'm pretty sure there are two types of Uranium, one is Uranium 235, and Uranium 238, but I'm not sure as this is off the top of my head. There is also Strontium 90, which I think was used in one of the Atomic bombs (could be wrong). The splitting of atoms is called nuclear fission, and was worked on and developed by the scientist Heisenberg (not sure who else).

Einsteins E=MC^2 which describes that Energy equals Mass times the speed of light squared can be used to calculate the amount of energy produced from nuclear fission.

My probably somewhat incorrect and misguided knowledge of radiation. The production of Nuclear energy creates radioactive waist. Being radioactive is not necessarily bad, but it's dangerous when things or objects are highly radioactive. Radioactivity is measured by the likeliness of a particle having a reaction with other particles around it. This is why the record sent on the Voyager shuttle was made of gold, gold has a very low radioactivity, which essentially means it decays more slowly, as apposed to vinyl which is relatively more radioactive. Waste materials from nuclear power plants have dangerously high levels of radioactivity and have had terrible health effects on people, and the environment. One of the biggest arguments against nuclear power generation is in regards to nuclear waste management. Some experts don't believe we have enough evidence to support weather or not it can be contained for the required amount of time for the radioactive materials to come back down to safe levels. There is also concern about the safety of nuclear power plants in the event of an accident that results in nuclear explosion, as the blast radius can be100's of kilometers, and the radioactive particles can travel thousands.

Despite the nuclear waste, and potential safety issues regarding nuclear energy, it is

still considered a clean energy source, as it's production does no create green house gas emissions like CO2/ Carbon Dioxide. Canada is heavily invested in nuclear energy, and because of this, our country has the lowest CO2 emissions in the world per kilowatt-hour produced.

I'm not sure what else I can say about nuclear energy off the top of my head. So let's get started!

What is Nuclear Energy?

- **Nuclear energy** is created from a chain-reaction where nuclear fission takes place
  - **Nuclear Fission** is the splitting of an element or atom.
    - Uranium is an element that allows for nuclear fission to take place easily. There are 2 isotopes of uranium:
      - U-235 is synthetic but capable of creating more energy
      - U-238 is the natural form
    - When atoms are split through fission, there is a release of energy
  - Nuclear energy can be used to create atomic bombs, electricity, and propulsion.

Why is it important?

- Nuclear energy is important because it creates electrical power with out the side effect of carbon emissions

Who was involved in the development of nuclear energy?

- Martin Klaproth, a German chemist 1789
  - Discovered Uranium
    - Named it after planet Uranus (cool fact)
- Wilhelm Rontegen 1895
  - discovered ionizing radiation (X-rays)
- Henri Becquerel 1896
  - Discovered beta radiation
- Villard (n.d.)
  - Discovered gamma rays. A third type of radiation
- Ernest Rutherford 1902
  - Discovered how to create a different element(particle) from radioactivity.
  - 1919 fired particles from radium to nitrogen and found nuclear rearrangement was occurring with the formation of oxygen
- Niels Bohr (through to the 1940's)
  - Bohr Diagrams (atoms as marbles not waves)
  - Advanced our understanding of atoms
  - Developed the classical analysis of the fission process
- Frederick Soddy 1911
  - discovered naturally-radioactive elements had a number of different isotopes w/ same chemistry
- George de Hevesy 1911
  - Showed that isotopes are invaluable as tracers

- James Chadwick 1932
  - Discovered the Neutron!
- Cockcrof and Walton 1932
  - produced nuclear transformations
- Irene Curie and Frederic Joliot 1934
  - Found that the some nuclear transformations created artificial isotopes(radionuclides).
- Enrico Fermi 1935
  - found more artificial raionuclides
  - found with uranium he could produce very light ones
- Otto Hahn and Fritz Strassmann in Berlin 1938
  - Demonstrated Atomic Fission
- Lise Meitner and Otto Frisch 1938
  - Explained Atomic Fission
  - Calculated to energy released from fission
    - 1939
    - Confirmed calculations to be accurate
    - This confirmation was the first experimental confirmation of Albert Einstein's paper putting forward the equivalence between mass and energy
  - Francis Perrin, and Rudolf Peierls 1939
    - introduced the concept of the critical mass of uranium required to produce a self-sustaining release of energy
    - Devised away of controlling the nuclear reaction (which is the basis for the operation of a nuclear power station)
    - Peierls was Werner Heisenberg's student
  - Werner Heisenberg from 1939
    - presided over the German nuclear energy project
  - Krill Sinelnikov, Pyotr Kapitsa, and Vladimir Verndasky 1920's and 30's
    - Russian physicists worked abroad as a way to raise the level of expertise quickly

Where was it developed?

- Paris, France
  - The 1939 developments in Paris found that nuclear fission could create self-sustaining chain reactions releasing enormous amounts of energy
- Germany
- USA
- Britain
  - During the war a Memorandum published by Frisch and Peierls suggested the potential of U-235 making a very powerful atomic bomb, how to detonate such a bomb, how U-235 could be produced, and what the raiation effects might be in addition to the explosive effects
  - 1940 Bitmingham University made the first small batch of gaseous uranium hexafuoride, a vital material for the future work
  - experimental proof that a chain reaction could be sustained with slow neutrons in a mixture of uranium oxide and heavy water
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- Russia
  - 1940
    - Advances in nuclear fission including chain reactions
    - The “Committee for the Problem of Uranium” established

When was nuclear energy first used?

- July 16 1945 first atomic device tested in Alamagordo, New Mexico
  - A plutonium device
  - no U-235 device was tested
- August 6 1945 first U-235 atom bomb dropped on Hiroshima, Japan
- August 9 1945 fitst Pu-239 atom bomb dropped on Nagasaki
- 1951 in Idaho, USA designed an operated by Argonne National Laboratory called the Experimental Breeder reactor (EBR-1)
- 1954 Soviet Union, the Phisics and Power Engineering (FEI) made the world's first nuclear powered electricity generator and began operation at the FEI in Obninsk.
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How does it work?

- As simply as possible;
  - When a Uranium atom is split it creates a new atom, which in turn can be split. It's possible to control this reaction to produce a self-sustaining chain-reaction where atoms continue to split new atoms. Each time an atom is split, there is energy released, and this energy is exponentially increased as the number of atoms in the reaction increase.

Summary

- Most of the work regarding nuclear physics was done from 1939 – 1945 during which much of the focus was on developing the atom bomb. Prior to this it's focus was on using nuclear fission as a means of generation electrical power, however because of the war, people where fearful that Germany might develop an atom bomb, and so allied countries, Britain, USA, and Russia, started focusing on the development of a bomb, and postponed research on it's potential for power generation.
- Because of the war, there had been many technological advancements in nuclear physics and physicists were redirected to focus on it's use for generating electricity.
- The focus on using nuclear fission as electrical power generation has continued through until today.

What do I think after reading this article??

- After reading this article I have realized that there were many important discoveries made by many physicists from all over the world. It has made me realize how little I knew about the history of nuclear energy.
- What I did not know, was how uninterested the US was in using the technology for mass destruction. According to this article, the US didn't step in until it seemed very likely that Germany was working on building a bomb, and if something wasn't done to stop the war, there could have been very different historical outcome.

Glossary / New words

half-life is the amount of time required for the amount of something to fall to half its initial value.