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Nuclear Power Plant Virtual Field Trip Lecture Notes

**Lecture notes do not necessarily always go in order of the slides**

- How many licensed nuclear power plants are there in the United States? ________________
- In what region(s) do most of these occur? a. Region I  b. Region II  c. Region III  d. Region IV
- Give two valid reasons why nuclear power plants are more numerous in some regions of the United States?
  1. ____________________________________________________________________________________
  2. ____________________________________________________________________________________
- Nuclear energy provides about 20% of the energy needs for the United States. Match the percentages that other energy sources provide:
  1. Natural Gas a. 52%
  2. Hydroelectric b. 3%
  3. Petroleum c. 7%
  4. Coal d. 16%
  5. Renewables e. 2%
- Where are most nuclear power plants concentrated worldwide?
  ________________________________________________________
- How much of the world's energy needs are provided by nuclear power? a. 20% b. 23% c. 78.8% d. 8.75%
- Nuclear power plants have helped avoid 90% of all carbon emissions and that benefits the planet's ecology. TRUE or FALSE
- One ton of natural uranium ore is equivalent to ____________ tons of coal and ____________ tons of oil.
- Give three methods of mining uranium.
  1. ____________________________________________________________________________________
  2. ____________________________________________________________________________________
  3. ____________________________________________________________________________________
- After uranium is mined it is directly ready for use? TRUE or FALSE
- Provide three major uses for uranium other than for power generation.
  1. ____________________________________________________________________________________
  2. ____________________________________________________________________________________
  3. ____________________________________________________________________________________
- What is the atomic number of uranium? a. 90 b. 91 c. 92 d. 93
- Describe the physical features of natural occurring uranium.
  1. ____________________________________________________________________________________
  2. ____________________________________________________________________________________
  3. ____________________________________________________________________________________
Use the following words to fill in the steps of the nuclear fuel cycle as it relates to power generation. (Health & Medicine, Fuel Fabrication, Waste Storage, Enrichment & Refinement, Industry & Research, Waste Disposal, Underground, Research & Power Reactors, Food & Agriculture, In Situ, Conversion / Processing, Open Cut, Power Generation (Electricity)).

What is meant by ‘yellow cake’. __________________________________________________________________

The “yellow cake” is converted into various uranium metal alloys or compounds and used as nuclear fuel after being formed into these shapes:

a. rods  
b. pellets  
c. plates  
d. all of the above

What three metals are commonly used to seal or "clad" the uranium and prevent the release of radioactive particles?

1. _____________________

2. _____________________

3. _____________________

How is in situ uranium mining different than surface or underground mining?

____________________________________________________________________________________________________

____________________________________________________________________________________________________

Put the processes of underground (open-cut) uranium mining in order:

_____ a. conversion

_____ b. crushed and finely ground into a paste

_____ c. sent to the closest mill

_____ d. sulphuric acid added

_____ e. uranium oxide concentrate is exported

_____ f. uranium-rich solution is filtered

_____ g. uranium-rich solution is separated and dried into yellow cake

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Define the following terms:
• decline -
• stope -
• skip -

List the two forms of mining waste: 1. ___________________ 2. ___________________

Any rock that does not contain useful materials is returned underground or stored on site. TRUE or FALSE

What is a mine tailing? How is a tailing rehabilitated?
____________________________________________________________________________________________________
____________________________________________________________________________________________________

Put the processes of in situ (solution) uranium mining in order:
_____ a. solution is pumped back to the surface through the production well
_____ b. boreholes are drilled
_____ c. mining solution is recycled
_____ d. treatment of aquifer injection wells with acid or alkali
_____ e. uranium solution to processing plant
_____ f. uranium is dissolved and leached from the orebody

Give five (5) advantages for in situ mining.
1. _____________________________________________________________________________________________
2. _____________________________________________________________________________________________
3. _____________________________________________________________________________________________
4. _____________________________________________________________________________________________
5. _____________________________________________________________________________________________

Uranium ore is considered to be a relatively abundant material. TRUE or FALSE

Uranium is very dense. What would a gallon jug weigh if it were filled with uranium? ________ pounds.

What is uranium’s melting point? _________________

Natural occurring uranium ore contains _____% of U-238 and _____% of U-235.

Which form of uranium is used in power generation and thus considered fissionable? _________________

Complete the following chart for uranium types:

<table>
<thead>
<tr>
<th>URANIUM TYPES</th>
<th>ISO TOPE #</th>
<th>PERCENT OF ISO TOPE</th>
<th>USED IN COMMERCIAL REACTORS</th>
<th>USED IN NAVAL PROPULSION</th>
<th>USED IN RESEARCH</th>
<th>USED IN WEAPONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Uranium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Enriched Uranium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly Enriched Uranium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depleted Uranium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is meant by uranium enrichment, and what is the main purpose for it?
____________________________________________________________________________________________________

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• UF6 stands for uranium hexafluoride. **TRUE** or **FALSE**

• What are the properties of UF6?

• Describe how uranium is enriched:
  1. Gaseous diffusion process -

• The UF6 stream with the greater U-235 concentration is known as depleted uranium. **TRUE** or **FALSE**

• What is radiation?

• List 3 sources of natural background radiation:
  1. 
  2. 
  3. 

• Radiation also comes from television, medical x-rays and inside the body. **TRUE** or **FALSE**

• Why is nuclear radiation carefully monitored?

• Name three (3) structures inside a nuclear reactor plant that keep uranium from interacting with the environment?
  1. 
  2. 
  3. 

• Radioactivity is the spontaneous emission of energy from ___________ atoms.

• Other elements with naturally occurring radioactive forms (isotopes) are:
  a. carbon   b. bismuth   c. radon   d. strontium   e. all of the above

• Radioisotopes are commonly used in medicine and are by-products of nuclear energy. **TRUE** or **FALSE**

• Contrast nuclear fission with nuclear fusion.

• Using the protons and neutrons of a 235 uranium atom, give the:
  1. atomic number
  2. atomic mass
  3. number of protons
  4. number of neutrons
• Describe what occurs in a chain reaction.

• What is meant by the term “fissile”?

• Nuclear reactions are controlled in power generation through the use of neutron absorbing control rods that can speed up or slow down the chain reaction. **TRUE** or **FALSE**

• What are the possible effects when a chain reaction gets out of control?

• Answer the following questions using the generalized diagram of a nuclear power plant:
  
  1. What is the end result produced in the confinement shell?
  
  2. Where is the reactor core located?
  
  3. What is the end result of the steam turbine?

• A natural water source and the cooling tower are two ways water is cooled in a nuclear power plant. **TRUE** or **FALSE**

• What is the advantage of a double loop design?

• Why is an external water source needed in the process of nuclear power generation?

• Cerenkov radiation is the characteristic green glow of the water surrounding the core of a nuclear reactor. **TRUE** or **FALSE**

• Give the **function** of the following reactor core components.
  
  1. Fuel -

  2. Control rods -

  3. Coolant -

  4. Moderator -

• Name the seven (7) layers used in a nuclear reactor to provide safety:
  
  1. 
  
  2. 
  
  3. 
  
  4. 
  
  5. 
  
  6. 
  
  7. 
• Nuclear power plants must shut down every 24 to 36 months to remove and replace the "spent" uranium fuel.  
  TRUE or FALSE

• Currently, how is nuclear waste stored in the United States?  

• Complete the following chart for levels of radioactive waste:

<table>
<thead>
<tr>
<th>LEVELS OF RADIOACTIVE WASTES</th>
<th>EXAMPLES</th>
<th>DISPOSAL METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-level Radioactive Waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate Radioactive Waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-level Radioactive Waste</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• The advantages of storing radioactive wastes in a water-filled concrete vaults are that the water cools and shields it from the environment.  TRUE or FALSE

• ________________ are the principle environmental concern of nuclear power generation.

• What long-range plan does the U.S. Department of Energy propose for the storage of nuclear waste?  

• The mission of the Nuclear Regulatory Commission is to ________________ the public health and safety and the environment from the effects of radiation.

• The NRC conducts the following activities regarding radiation:  
a. policy formulation  b. dissemination of information  c. adjudication and oversight  d. all of the above

• Name and describe two (2) major nuclear accidents, be sure to include possible causes:
  1. _____________________________________________________________________________________________  
     _____________________________________________________________________________________________  
     _____________________________________________________________________________________________
  2. _____________________________________________________________________________________________  
     _____________________________________________________________________________________________  
     _____________________________________________________________________________________________

• List two (2) radioactive contents of the reactor core that were released into the atmosphere during the disastrous Chernobyl accident:
  1. ________________________
  2. ________________________

• Radiation induced cancer is the most major health illness seen from nuclear accidents.  TRUE or FALSE

• Leukemia is the most sensitive ____________________ of radiation-induced effects.