



Course Information – CHEM 196 – Nuclear Power



Course Description

An examination of nuclear power as a current and future source of energy. Topics include introduction to science and technology of nuclear reactors, the nuclear fuel cycle and nuclear waste, history of nuclear power generation in the U.S. and other nations, economic, legal, and environmental issues, risks associated with proliferation of nuclear weapons and terrorist attacks, and a comparison of nuclear power with other source of energy.



Course Objectives

Students will first become familiar with the science and technology of the radioactivity, nuclear fission, nuclear fuel cycle, nuclear reactors, electricity distribution. They will then be responsible for addressing issues the following issues associated with nuclear power: economics, legal and regulatory (domestic and international), proliferation of nuclear weapons, terrorist attacks on nuclear power facilities, and the position of nuclear power relative to other sources of energy. They will be responsible for calculations involving energy production and radioactivity. Written work will include responses to topics on discussion boards and a term paper. Oral work includes participation in class discussions (assigned as topic on discussion board) and a final presentation of a topic of interest from their term paper.



Course outline

The concept map provides an overview of the topics and their relationships. Start at the upper right on the map with "science and technology" and move clockwise to obtain the general sequence of topics. The "e" or symbol icons represent links to sites related to the specific topic. The paper clip icons provide links to files containing presentations on the topic and bibliographical information from eth Alsos Digital Library for Nuclear Issues.



Text Books and Resources

Hore-Lacy, Ian. Nuclear Energy in the 21st Century. 7th. London: World Nuclear Press, 2006.

Smith, Brice. Insurmountable Risks. 1st. Takoma Park, MD: IEER Press, 2006.

Assigned material from websites and files available from the concept map.

Searchable, annotated bibliographies on selected topics from the [Alsos Digital Library for Nuclear Issues](#).



Grading

4 short papers (2 pages) submitted to the discussion board to be used as background for class discussions (20%)

class discussion – participation (10%)

2 tests (30%)

Final paper with checkpoints (30%) The paper should be between 2500 and 3500 words in length not counting figures, tables, and references (end notes). You should use (cite) a minimum of 10 references with at least 5 non-website citations.

Initial topic and description - 5%

Outline - 5%

Peer review - 5 %

Final paper - 15 %

Final presentation (10%)

Attendance – 2 absences allowed



Avoiding Plagiarism

W&L students frequently express concerns about inadvertently committing plagiarism, described in the *2003-2004 Student Handbook* as "the use of another's words or ideas without proper acknowledgement." The resources listed in this URL should be considered as sources of advice about what constitutes plagiarism and how to avoid it.



The Citation Machine

Citation Machine is an interactive Web tool designed to assist in modeling the proper use of information property. You merely...

1. Click the type of resource you wish to cite,
2. Complete the Web form that appears with information from your resource, and
3. Click **Make Citations** to generate standard MLA citations.



Syllabus



Introduction (09/07 - 09/10)



Basic Science and Technology (09/12 - 09/17)

The history, science, and technology associated with nuclear energy. Refer to the concept map for organization of topics, links and references.



Nuclear Reactors (09/24/07 - 09/27/07)

Description of generic reactor components and operation, types of current reactors in operation and future reactor development. Refer to the concept map for organization of topics, links and references.



Nuclear Fuel Cycle (10/01/07 - 10/03/07)

Descriptions of components of the open and closed uranium fuel cycles and also potential use of thorium as fissile material.



Electricity Generation and Distribution (10/08/07)

Basic principles of electricity generation and distribution



First Exam (10/10/07)

Examination on Science and Technology Topics



Economics of Nuclear Power (10/15/07)

Cost associated with building, financing, operating, and dismantling nuclear power plants. Comparison with cost of producing electricity with other major sources.



Legal and Regulatory Issues (10/17/07 - 10/22/07)

Discussion of legal and regulatory issues associated with nuclear power. Domestic and international agencies and organizations. US legislation relating to nuclear power including the Energy Acts of 2005 and 2007.



Nuclear Power in Other Nations (10/24/07 - 10-29-07)

History and Current Status of Nuclear Power in France, Japan, and the UK



Poliferation and Terrorist Risks (10/31/07 - 11/05/07)

Risks associated with nuclear poliferation and terrorist attacks using nuclear devices or materials including a attacks on nuclear facilities, theft of materials, and acquisition of an intact nuclear weapon.



Insurmountable Risks? (11/07/07 - 11/12/07)

Dr. Brice Smith, Author of *Insurmountable Risks*, will be with the class on Nov. 12.

Outline of term paper due



Comparison of Nuclear with Other Energy Sources (11/14/07)

Comparison of nuclear power with coal, coal with carbon capture, hydro, wind, solar, and biofuels.



Second Exam (11/28/07)



Student Presentations (11/26/07, 12/03/07 - 12/05/07)

Term paper due by 5 PM on Friday December 7



Introduction (09/07 - 09/10)



Friday - 09/07/07

Course mechanics - goals, grading, texts, and use of Blackboard

Sources and uses of energy in US and worldwide

[Energy Units and Conversions](#)

Chapter 1 Hore-Lacy

Getting Power to the People (handout) intro 27-30 and nuclear 32-35

Nuclear Energy: Balancing the Benefits and Risks (handout)

A Plan to Keep Carbon in Check (handout)

[Dr. Settle's Introduction](#)



Monday 09/10/07

Class discussion of DB #1

[Early History of Nuclear Science](#)

[Discovery of Radioactivity and Its Impact on Science](#)

[The Manhattan Project and its Legacy](#) (finish on Wednesday if necessary)

Chapter 9 Hore-Lacy

Read the History of the Manhattan Project (link on concept map under history United States)

[Worksheet #1](#) Turn in on Wednesday

OK



Basic Science and Technology (09/12 - 09/17)



Wednesday 09/12/07

[History of US Nuclear Power](#)

[Who Killed Nuclear Power in the US?](#)

Read [Nuclear Radiation](#) and [Radioactive Half-Life](#)

Be able to calculate the amount of a radioactive isotope remaining after a given time, t , given the half-life and the original amount of the isotope.

Understand the significance of the units used to measure emitted and absorbed radiation.

[Fundamentals.ppt](#)

Read "[Biological Effects of Radiation](#)"

Define the major types of nuclear radiation and their biological effects.



Monday 09/17/07

Fission fundamentals - Dr. THomas Williams - **Class meets from 3:30 to 4:30**

[Dr. William's Notes](#)

View [Fission Fundamentals](#)

Read material on fission at "[Some Physics of Uranium](#)"

Explore [the chart of the nuclides](#)



Wednesday 09/19/07

No class today

Prepared answers to work sheet #2 which are due on Monday September 24.

[Worksheet #2](#)

Read the assigned materials on nuclear reactors for class on September 24.

OK



Basic Science and Technology (09/12 - 09/17)



Wednesday 09/12/07

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OK



Nuclear Fuel Cycle (10/01/07 - 10/03/07)



Monday 10/01/07

Nuclear Fuel Cycle - Front End

Hore-Lacy 3.3, 4.1, 4.2

Smith 3.1

[Brief description of fuel cycle](#)

[More detailed description of fuel cycle](#)

[Dr. Settle's Notes](#)



Wednesday 10/03/07

Nuclear Fuel Cycle - Back End

Hore-Lacy Chapter 5

Smith Chapter 5

[Radioactive Waste Management](#)

[Managing Spent Fuel - von Hippel](#)

[Dr. Settle's Notes](#)

[Yucca Mountain](#)

[Work sheet # 4](#)

[Term Paper Topics](#)

OK



Electricity Generation and Distribution (10/08/07)



Monday 10/08/07

[Electricity basics](#) - a quick review

Transmission and distribution of electricity

Hore-Lacy Chapter 2

[US Power Grid](#)

[Electricity - DOE](#)

Nuclear Power Generation in the US

[Locations and Descriptions of US Plants](#)

[Current Information from US EIA](#)

[CBS Eye on Energy](#)

OK

CHEMISTRY 196 SECT 01 (2007_08_FALL-CHEM_196_01) > SYLLABUS > ECONOMICS OF NUCLEAR POWER (10/15/07) [EDIT VIEW](#)



Economics of Nuclear Power (10/15/07)



Monday, October 15

Economics of nuclear power

Discussion board #3 due by class time on Monday

[Economics Notes](#)

Smith pp 29-55

Hore-Lacy pp 34-36

[Economics Report - Harding](#)

[Economics Report - Uranium Institute](#)

[Executive Summary - MIT Report](#)

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CHEMISTRY 196 SECT 01 (2007_08_FALL-CHEM_196_01) > SYLLABUS > LEGAL AND REGULATORY ISSUES (10/17/07 - 10/22/07) [EDIT VIEW](#)



Legal and Regulatory Issues (10/17/07 - 10/22/07)



Wednesday, November 17

Domestic Legal and Regulatory Issues - Mr. Albert Carr, adjunct professor, W&L Law School

Blackboard #4 - Select the topic for your paper with several paragraphs describing what you plan to present. Include five initial references.



Monday, October 22

International Regulation, Treaties, and Agreements - Dr. Settle

Discussion Board #5 due by class time

[Dr. Settle's Notes](#)

[International Atomic Energy Agency \(IAEA\)](#)

[IAEA Safeguards: Staying Ahead of the Game](#)

[Nuclear Nonproliferation Treaty](#)

[Nuclear Suppliers Group \(NGS\)](#)

[International Panel on Fissile Materials](#)

[Global Fissile Material Report 2006 pp 32-56](#)

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CHEMISTRY 196 SECT 01 (2007_08_FALL-CHEM_196_01) > SYLLABUS > NUCLEAR POWER IN OTHER NATIONS (10/24/07 - 10-29-07) [EDIT VIEW](#)



Nuclear Power in Other Nations (10/24/07 - 10-29-07)



Monday, October 29

Nuclear power in France, the UK and Japan

France

[History of Nuclear Power in France](#)

View [Sixty Minutes Segment on French Nuclear Power](#)

[Information on Current Status](#)

Japan

[History and Current Status](#)

[Federation of Electric Power Companies of Japan \(FEPC\)](#)

The UK

[History and Current Status](#)

[Nuclear Power in the UK](#)

India

[US-India Nuclear Deal](#)



Wednesday, October 24

No class today

Class will be made up with DR. Ferguson's lecture on November 5 at 7:30 PM in the C-school.

Work on outline for your paper.

OK

[CHEMISTRY 196 SECT 01 \(2007_08_FALL-CHEM_196_01\) > SYLLABUS > POLIFERATION AND TERRORIST RISKS \(10/31/07 - 11/05/07\)](#)

[EDIT VIEW](#)



Poliferation and Terrorist Risks (10/31/07 - 11/05/07)



Wednesday, 10/31/07

Proliferation Issues - Dr. Robert Strong, Professor of Political Science, W&L



Monday - 11/05/07

Dr. Charles Ferguson, Science Fellow, Council of Foreign Relations, Washington, DC.

OK

[CHEMISTRY 196 SECT 01 \(2007_08_FALL-CHEM_196_01\) > SYLLABUS > COMPARISON OF NUCLEAR WITH OTHER ENERGY SOURCES \(11/14/07\)](#)

[EDIT VIEW](#)



Comparison of Nuclear with Other Energy Sources (11/14/07)



Monday, November 12

Dr Settle will lead class discussion on a comparison of nuclear power with other energy sources.

OK

[CHEMISTRY 196 SECT 01 \(2007_08_FALL-CHEM_196_01\) > DISCUSSION BOARD](#)



Discussion Board

Forum

Search

Search

in

After

Oct 26 2007

Before

Oct 27 2007

| Display Order | Forum | Total Posts | Unread Posts | Total Participants | | | | |
|---------------|--|-------------|--------------|--------------------|--------|--------|--------|------|
| 1 | Discussion Board #6 - Global Nuclear Power | 1 | <u>1</u> | 1 | Modify | Manage | Remove | Copy |

Assignment due by class time on Monday, October 29

Research the following for your assigned country. A short paragraph on each issue will be fine. Include numerical data on the issues.

- 1) Short history of nuclear power (first nuclear plant and rate of expansion)
- 2) Current status of nuclear power generation (# and type of reactors, total capacity, capacity factor)
- 3) Contribution of nuclear power to electricity generation in the country and other source of electrical energy.
- 4) Uranium supply
- 5) Fuel cycle facilities (if any) including reprocessing facilities (if any).
- 6) Regulation and safety
- 7) Future plans for expanded nuclear power (# and types of reactors, fuel cycle facilities)

You will find some information in Hore-Lacy. Most is found in the links under "Nuclear Power Generation by Country" in the [nuclear power concept map](#)

| | |
|----------|-------------|
| Allaband | Belgium |
| Bruno | Canada |
| Cleary | China |
| Coker | Finland |
| Ferguson | France |
| Gockley | Germany |
| Grijalva | Japan |
| Klein | South Korea |
| Rowe | India |
| Snoddy | Russia |

Sweet UK
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|---|---|----|---|----|---------------------------|
| 2 | Board #5 - The Nuclear Non-proliferation Treaty (NPT) | 12 | 0 | 12 | Modify Manage Remove Copy |
| <p>Due by class time on Monday October 22.</p> <p>After reviewing the text NPT, discuss the application of the treaty to civilian uses of nuclear energy including nuclear power.</p> <p>How do the articles of the treaty distinguish between weapons related activities and civilian applications of nuclear energy?</p> <p>What obligations to the weapons states have to the non-weapons states?</p> <p>What responsibilities regarding civilian applications of nuclear energy do non-weapons signatories have under the treaty?</p> | | | | | |
| 3 | Board #4 Economics of Nuclear Power | 14 | 0 | 14 | Modify Manage Remove Copy |
| <p>Read the Harding Report and discuss the following issues:</p> <p>Pressure for new nuclear power</p> <p>Constraints on new nuclear power</p> <p>Economics of open and closed fuel cycles</p> <p>Effect of carbon constrains on new nuclear power</p> <p>Your conclusions concerning new nuclear power plants</p> | | | | | |
| 4 | Topic and Description of paper | 13 | 0 | 13 | Modify Manage Remove Copy |
| <p>Provide a tentative title for you paper along with several paragraphs describing what you intend to present and five initial references. Due by class time on Wednesday, October 17.</p> | | | | | |
| 5 | Reactor Safety Post your arguements here. | 14 | 0 | 14 | Modify Manage Remove Copy |
| 6 | Board # 1 -- Nuclear Power - Assets and Liabilities | 15 | 0 | 15 | Modify Manage Remove Copy |
| <p>After reading the two handouts (Power to the People and Nuclear Energy), provide a list of the major advantages and disadvantages of nuclear power. Write a brief paragraph for each item you list. You should have a minimum of three items in each category. Please enter your discussion by noon on Monday, Sept. 10.</p> | | | | | |

