

1. Should we store our nuclear waste in Yucca Mountain + other questions below

Background Radioactive waste is a by-product of many applications of nuclear physics, including electricity generation, weapons, and medicine. Due to the large quantities and long half-lives of the materials involved, this waste is expected to remain hazardous and thus require storage for tens of thousands to millions of years.

Currently, the United States' nuclear waste is scattered in many sites around the country. The Department of Energy (DoE) is working on a proposal to relocate all the waste to one permanent site in Yucca Mountain, which is approximately 100 miles northwest of Las Vegas, Nevada. The Yucca Mountain site was chosen after extensive study of its location, climate, and geology, as well as that of other potential sites.

Despite the considerable research gone into the site, it remains controversial. Many residents of Nevada don't want nuclear waste "in their backyard". Concerns have also been raised about how good various aspects of the storage plan are, including the site's geologic stability and the amount of time it's expected to contain radiation for.

The question of whether to build more nuclear power plants is closely related to the question of whether to store nuclear waste in Yucca Mountain: The more difficult it is to store nuclear waste, the less attractive an option building more nuclear power plants is.

Potential Witnesses Public comments from a recent DoE meeting are available online at: http://www.ocrwm.doe.gov/ym_repository/studies/seis/eis-comments.shtml
These comments include individuals both supporting and opposing the Yucca Mountain plan. Each side may choose one person from this list.

There are prominent US politicians both supporting and opposing the Yucca Mountain plan. Those supporting include President Bush (R-TX); those opposing it include Senate Majority Leader Harry Reid (D-NV) and Senator John Kerry (D-MA). Each side may choose one politician.

Other people/groups supporting Yucca: Scientists...

Other people/groups opposing Yucca: The Sierra Club, a prominent environmental organization (see www.sierraclub.org/nuclearwaste/yucca_factsheet.asp)

Questions What specific materials would be stored at Yucca Mountain? What type of radioactive decay do they undergo? What are their half-lives?

How would nuclear waste be transported from where it's currently being stored to Yucca Mountain?

What radiation levels would be coming from Yucca Mountain? What levels are considered safe?

What alternative options exist, and how do they compare?

How may this debate be influenced by electoral politics? (Hint: Nevada is a swing state.)

What are other countries doing with their radioactive waste?

What conflicts of interest do those involved with the issue have?

References The U.S. Department of Energy, http://www.ocrwm.doe.gov/ym_repository, has a lot of good information about the project from the US government's perspective. Its information should be quite accurate, although it may have a pro-Yucca slant.

Wikipedia has several good, relevant articles. Start at http://en.wikipedia.org/wiki/Yucca_Mountain. Wikipedia content cannot be trusted 100%. However, it is usually fairly accurate, and provides an excellent starting point for learning more.

Google News can provide recent news articles on the topic. See news.google.com/news?hl=en&ned=us&q=yucca+mountain

Last But Not Least Some questions for you to consider on your own. (This is not part of the debate activity.)

- Would we be better off had nuclear physicists not done all this work, bringing us nuclear power, weapons, and medicine?
- What will you do in your career when faced with opportunities to do work of questionable ethical soundness?

2. Should we build more nuclear power plants?

Background

Nuclear power plants perform nuclear reactions to generate electricity. The plants perform nuclear fission, a controlled chain reaction in which converts heavy atoms such as uranium and plutonium to lighter atoms, alpha and beta particles, and energy which boils water, driving a steam turbine.

The world gets about 7% of its energy from nuclear power. The world's energy consumption is currently growing and is projected to continue growing indefinitely. Without more nuclear power plants, the world would need more energy from other sources. Alternatively, by building more nuclear power plants, the world could avoid generating energy via other means, such as fossil fuels.

There are advantages and disadvantages to nuclear power, and there is a heated debate about whether we should build more plants. The issue touches on many aspects of society, including pollution, climate change, resource depletion, weapons proliferation, and economic vitality.

The question of whether to build more nuclear power plants is closely related to the question of whether to store nuclear waste in Yucca Mountain: The more difficult it is to store nuclear waste, the less attractive an option building more nuclear power plants is.

Potential Witnesses

Given the diversity of the topic, there are many great potential witnesses.

For more nuclear power plants:

- Nuclear power is cited as a means of mitigating climate change: Nuclear power results in much less greenhouse gas emission per amount of electricity produced than fossil fuels.

- Despite widespread concern, nuclear power can be generated safely. The Three Mile Island meltdown was successfully contained and did not harm the population; the Chernobyl meltdown caused so much damage due to lack of oversight, not due to any fundamental problem with nuclear power.
- Compared to other “alternative” energy sources, such as wind, solar, and geothermal, nuclear power is already capable of being implemented cost-effectively on a large scale.
- Existing nuclear material should be able to power nuclear plants for at least tens of thousands of years. Fossil fuels may run out within tens or hundreds of years.

Against more nuclear power plants:

- While nuclear meltdowns can be contained, something still could go wrong, as happened at Chernobyl. These accidents are very disastrous.
- Nuclear power can result in nuclear weapons proliferation, since the technology, materials, and expertise required for nuclear power is similar to that needed for nuclear weapons.
- Alternative options, such as solar, wind, and geothermal power, as well as energy conservation, avoid the problems associated with nuclear power.
- While nuclear power is an effective means of generating electricity, it is not well-suited for transportation.

Questions What radioactive materials are required for nuclear power generation? How abundant are they?

What is the difference between fission and fusion? Which of these do nuclear power plants use?

Does the production of nuclear power result in greenhouse gas emission?

How safe is nuclear power? How safe are the alternatives?

How easily can solar, wind, and geothermal meet our energy consumption? How easily can our levels of energy consumption be decreased?

What conflicts of interest do those involved with the issue have?

References HowStuffWorks has an article “How Nuclear Power Works” at <http://www.howstuffworks.com/nuclear-power.htm>.

The Sierra Club, an environmental advocacy organization, recently published a piece opposing nuclear power. See “Why Not Nukes?”, <http://www.sierraclub.org/sierra/200701/nukes.asp>.

The Nuclear Energy Institute, an organization sponsored by the nuclear power industry, as a lot of information on nuclear power activity and opinion on why the U.S. should use nuclear power. See <http://www.nei.org/>, especially the “Public Policy Issues” section.

Wikipedia has several good, relevant articles. Start at http://en.wikipedia.org/wiki/Nuclear_power_controversy and http://en.wikipedia.org/wiki/Sustainable_energy. Wikipedia content cannot be trusted 100%. However, it is usually fairly accurate, and provides an excellent starting point for learning more.

Almost Last But Not Least Some questions for you to consider on your own. (This is not part of the debate activity.)

- Would we be better off had nuclear physicists not done all this work, bringing us nuclear power, weapons, and medicine?
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3. Should the United States develop low-yield “bunker buster” nuclear weapons?

Background Regular nuclear weapons are powerful enough to destroy an entire city, as was done with Hiroshima and Nagasaki. Low-yield nuclear weapons, however, generate much smaller explosions, and thus can be used for more precise tactical operations, such as “bunker busting”, i.e. the destruction of underground bunkers. The weapons penetrate underground before explosion, maximizing impact on the bunker and minimizing the radiation released into the environment.

Despite the differences between regular and low-yield nuclear weapons, development of the latter faces similar controversy as the former. Low-yield nuclear weapons have existed since decades. The United States recently (2003) proposed developing further low-yield nuclear weapons, but that proposal was abandoned, as it would have required reversing long-standing US policy on nuclear weapons non-proliferation.

Very recently (Sunday, January 7, 2007), the London Times reported that Israel is considering using nuclear bunker busters to destroy Iran’s own nuclear facilities. This matter is ongoing and cannot be considered confirmed. Officially, Israel does not state whether it has nuclear weapons.

Potential Witnesses U.S. politicians who supported or opposed the development of nuclear bunker busters when President Bush proposed it in 2003. See the Washington Post: “Bush Request to Fund Nuclear Study Revives Debate” for details.

The *Union of Concerned Scientists* **opposed the development of nuclear bunker busters**. Their national headquarters is in Harvard Square and they may be accessible for comment. See <http://www.ucsusa.org/ucs/about> for contact info.

At least some people at the U.S. Department of Defense supported the development of nuclear bunker busters. See the Washington Post, “Rumsfeld Seeks to Revive Burrowing Nuclear Bomb”.

The National Review, a conservative political magazine, published an article in support of the development of nuclear bunker busters. See National Review Online: “Bunker-Buster Debunker”.

Questions How do nuclear bunker busters work? (Hint: How does the “bunker buster” part work? How does the “nuclear” part work?)

How much radiation from a nuclear bunker buster would end up above ground and able to harm people? For how long would that radiation remain?

What alternative technologies exist? How do they compare to nuclear bunker busters?

How would the US developing nuclear bunker busters affect nuclear proliferation around the world?

What is the Comprehensive Test Ban Treaty? Is the U.S. part of it? Should it be?

Does the CTBT cover bunker busters? Should it?

What conflicts of interest do those involved with the issue have?

References Wikipedia has several good, relevant articles. Start at http://en.wikipedia.org/wiki/Nuclear_bunker_buster. Wikipedia content cannot be trusted 100%. However, it is usually fairly accurate, and provides an excellent starting point for learning more.

For recent news articles on Israel's possible use of nuclear bunker busters in Iran, search for *bunker buster* on Google News (news.google.com).

For information on the recent U.S. proposal to develop nuclear bunker busters, search for *bush "bunker buster"* on Google (google.com).

- American Institute of Physics: "Nuclear Bunker Busters, Mini-Nukes, and the US Nuclear Stockpile" - Excellent article on the politics and physics of the US's recent consideration of nuclear bunker busters
- Washington Post: "Bush Request to Fund Nuclear Study Revives Debate" - An article that provides more detailed coverage on the political side of the recent U.S. proposal to develop nuclear bunker busters.

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4. Should the Iranian nuclear program be permitted to proceed?

Background In 2003 the Iranian government made public its intention to pursue nuclear power. The stated goal of the Iranian government is generate 7,000 megawatts of electricity through nuclear power plants by 2020. In addition to generating nuclear power, the Iranian government is pursuing a program to generate enriched uranium (U-235) for its reactors.

Under the Treaty on the Non-Proliferation of Nuclear Weapons, a country has the right to make its own nuclear fuel - as long as the process is closely monitored. Most countries that generate nuclear power import the fuel they need. The International Atomic Energy Agency - the UN body responsible for monitoring the treaty - has been attempting to work with the Iranian government to develop a process that will ensure the world that the Iranian nuclear program is for peaceful purposes.

However, the United States and other members of the United Nations Security Council have expressed concern regarding the Iranian nuclear program. The concern stems from the fact that the process that makes nuclear power fuel, though, can also be used to make material that can be used in nuclear weapons. The concern was fueled by that fact that the United States uncovered evidence that the Iranians had, until as recently as 2002, a clandestine nuclear weapons program.

The question is whether Iran should be permitted to undertake its nuclear program under the present monitoring system – the IAEA – or whether the United States and/or the United Nations security council should take further actions to ensure that Iran does not pursue nuclear weapon's development.

Potential Witnesses Much is being and has been written about this topic. Relevant to this topic is the recent National Intelligence Estimate on Iran's nuclear intentions and capabilities (http://www.dni.gov/press_releases/20071203_release.pdf)

The IEAE recently released a statement on the Iranian nuclear program (<http://www.iaea.org/NewsCenter/Focus/IaeaIran/index.shtml>)