let's LOOK at

Nuclear Power Plant Safety

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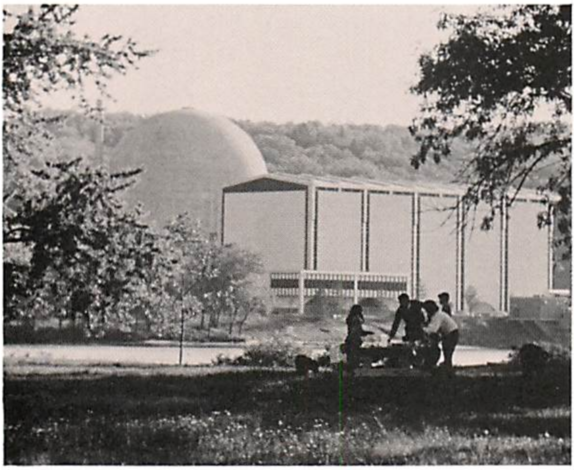
By the beginning of 1984, the United States commercial nuclear power industry had accumulated operating experience that corresponds to running one nuclear power plant for more than 800 years, or two for 400 years, or . . .

However you figure it, that's more than 800 reactor-years of operating experience, with an impeccable safety record.

That's a lot of safe operation — in any industry, by any standards. No other large-scale industry can equal nuclear power's record. This is the foundation for the industry's claim that commercial nuclear power is not only economical and a wise use of our natural resources, but safe as well.



Moreover, this claim of safety is based not only on what we've done since 1957, when the first commercial reactor began to produce electricity for America, but also on what we're doing every day. The threefold efforts to ensure continued safe operation are as follows:

- Extraordinary care in plant design and operation
- Continuous monitoring of plant operation by government inspectors
- Independent evaluation of risk by scientists and engineers

The technology that produces electricity by harnessing the energy of nuclear fission is relatively new, and relatively complex. Nevertheless, it is well understood by those who manage it. With the public, however, certain questions persist. People are worried when they hear talk about explosion, meltdown, radiation release, Three Mile Island . . . about risk.

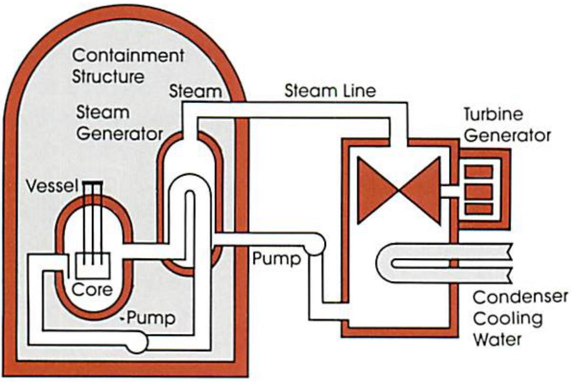
Let's look at these worries one by one.

Nuclear explosion? No way. There are fundamental physical reasons why a nuclear power plant cannot explode like a nuclear weapon, even though both devices rely on the fission process.

A nuclear weapon is designed for the largest possible release of energy over a very short period of time, with as little material as possible. In contrast, nuclear power plants are designed for controlled generation of energy, heat energy. In a bomb, the concentration and purity of fissionable material is very high — greater than 95 percent; in a nuclear power plant, it is very low — about 3 percent.

The risk in a commercial nuclear power plant is not explosion; it is loss of control of the heat produced by nuclear fission. This is the first of the two essential issues of nuclear safety. It is vital to keep the nuclear fuel adequately cooled, to take the heat away as it is produced.

Pressurized Water Reactor



In a light water reactor, the type of nuclear power plant built in the United States today, the heat is taken away by continuously circulating water. The water moves through the reactor vessel, takes heat from the fuel rods, and then proceeds to a steam generator, where it gives up its heat. Cooler now, the water returns to the reactor vessel to do its job again . . . and again and again. The steam produced in the steam generator turns the turbine to make electricity.

So it's essential to keep that water there . . . not just to keep the turbine producing electricity, but to keep the fuel cooled as well. If the fuel should get too hot, it could melt. It's highly unlikely, but it's conceivable, that the multiple barriers surrounding the fuel — the 8-inch-thick steel reactor vessel that holds the fuel, and even the 10-foot-thick concrete containment building floor — could also melt. Breach of the containment floor or walls could lead to a release of radiation to the environment.

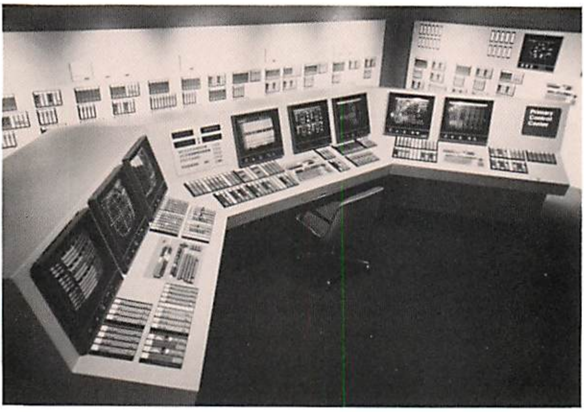
The potential for release of radiation is the second basic issue in nuclear safety. These, then, are the two important concerns — keeping the fuel cool, and keeping the radioactive materials out of our environment. The nuclear plant builders and suppliers, the utilities, and the nuclear regulatory agencies take these concerns very seriously.

The basic philosophy of nuclear reactor safety is multiple-level protection . . . providing several protection levels built into the plant design and its operating proecedures.

The first level of protection consists of using components that will operate with a high degree of reliability. The designers and builders use high-quality components that are designed to work effectively under all plant conditions. And then back them up with more high-quality components . . . this is called redundancy. That is, two or more components or systems are provided, so that reactor cooling will continue even if the first set of components or systems fails.

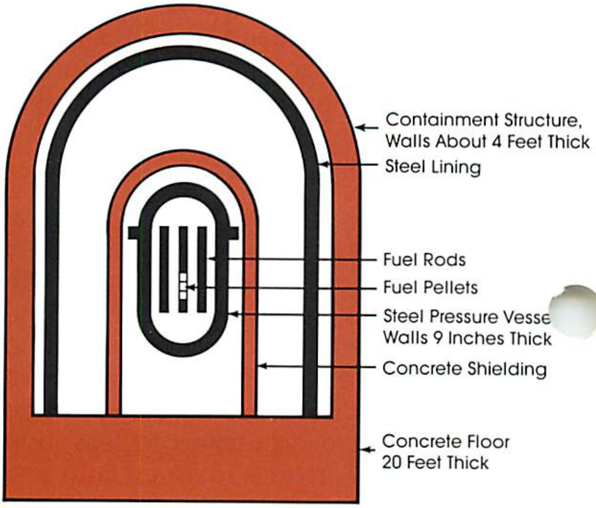
The second level of safety is the protection system, which is designed to prevent, arrest, or safely accommodate a wide range of abnormal conditions. Mechanical equipment, no matter how good, can fail; operators, no matter how well trained, can make errors; storms can damage exterior parts of the plant. Any of these occurrences may cause a deviation from normal operating conditions . . . a "transient." Automatic controls are provided within the reactor system to handle transients safely. For example, instruments will detect changes in reactor power or coolant water temperature, and automatically adjust control rods or coolant water flow. If the transient is more serious, the reactor can be shut down, either automatically or manually.

Nuclear Power Plant Control Room



Another aspect of the protection system is provided by multiple barriers to prevent radiation release to the environment. These barriers consist of the fuel, its cladding, the pressure vessel, and the containment building. The fuel is in the form of ceramic pellets which trap the fission products within their structure. The fuel pellets are sealed in metal tubes to provide a second barrier. The fuel rods are enclosed within a strong steel pressure vessel which, in turn, is inside the containment building. The containment building is a massive steel and concrete structure capable of withstanding explosions, earthquakes, tornadoes, and airplane crashes.

Multiple Barriers to Radiation Release



After the protection systems comes the third level of safety — *engineered safety features.* These are additional mechanical systems and radiation barriers, and they include the emergency core cooling system — a completely separate water system to flood the core with coolant in case of a major pipe break in the primary cooling system.

These separate levels — reliability, protection systems, and engineered safety features — constitute *defense in depth.* Defense in depth is a combination of many different ways to ensure that nuclear power does not adversely affect the public and the environment.

The question is, does it work? And that's a valid question, especially in view of the accident at the Three Mile Island nuclear power plant.

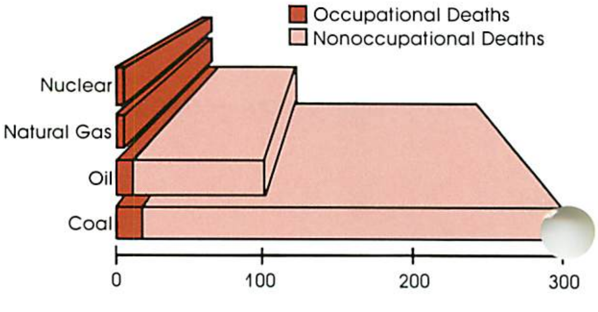
On March 28, 1979, a series of mechanical and human failures resulted in partial uncovering of the core in Unit 2 at Three Mile Island. That is, the level of the water covering the nuclear fuel dropped, and the heat generated by radioactive decay was not removed as promptly as it should have been.

In other words, the first level was inadequate; the system was not as reliable as it was thought to be. But the multiple levels of protection came through, to prove the value and the validity of the defense-in-depth concept. The core did not melt, and the amount of radiation that escaped the plant was small; the average individual exposure amounted to less than what a person would have received from one dental X-ray. The maximum exposure to any individual was about 70 millirems, which is equivalent to the additional amount that a resident of the TMI area would receive annually if he moved to Denver, where the natural background radiation is higher.

Does Three Mile Island mean that nuclear power is not as safe as the industry, the government, and independent scientists said it was? No, it doesn't. No responsible person ever said an accident couldn't happen — only that the probabilities were low. And they still are . . . even lower now, in fact, because a lot was learned at Three Mile Island. These lessons are being used to make nuclear power plants even safer.

Comparison of Risks of Energy Sources

All figures are for electric power production per 1000 MWe electric units per year and represent the upper end (worst case) of a predicted range.



In fact, several studies have indicated that nuclear energy is (along with natural gas) the safest way of generating electricity. One group of scientists estimated that even if the risks of injury from nuclear electricity generation were 10 to 100 times worse than they've been judged to be, they'd still be lower than those from coal, oil, or hydroelectric power generation. The American Medical Association looked at the effect on public health and safety of four types of electric generating facilities — coal, oil, nuclear, and natural gas — from the initial acquisition of the fuel through transportation, operation (including potential accidents), and waste disposal. They found that oil has 100 times the health and safety impact of nuclear, and coal's effects are 300 times greater!

There are risks associated with everything we do. Consciously or unconsciously, we are always weighing the risks of a course of action against its potential benefits. The benefits of nuclear power — the economic advantage, the domestic resource advantage — far outweigh the risks.

Nuclear power involves risks. But the technology is well understood, the safety concerns are carefully addressed, and the risks are low no matter how you look at them.

Nuclear power plants work — safely.

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