STATEMENT SUBMITTED
IN RESPONSE TO THE
SUPPLEMENTAL YUCCA MOUNTAIN EIS
OFFICE OF LOGISTICS MANAGEMENT
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY

MEETING AT RENO NEVADA
November 27, 2006

PRESENTED BY
ROBERT T. RAMSEY PE
[redacted]

SUBMITTED: NOVEMBER 27, 2006

Background

Yucca Mountain Today

The State of Nevada and the DOE are locked into an irreconcilable dispute over the future of the Yucca Mountain Repository.

On July 10, 2006, the DOE announced a schedule that proposes an opening date of March 31, 20017.

On August 10, 2006, Nevada governor Kenny Guinn wrote in the Reno Gazette-Journal (RGJ) that the "Yucca plan may soon be put to rest".

On September 8, 2006 Marvin Fertel from Nuclear Energy Institute wrote in the same paper that "Repository will open, and it will be safe".

Another article on November 13, 2006 after the elections by Associated Press had a quote: "As majority leader, we are confident Senator Reid can stop Yucca Mountain in its tracks".

November 22, 2006, RGJ, "Reid answers questions from RGJ readers"

Q: What do you think we should do about nuclear waste if the Yucca Mountain project is killed?

A: On-site storage is the best solution: it's safe now for years and years to come, and as the industry innovates, on-site storage will become even safer.

Also an editorial on the same date: "End of road for Yucca Mt."

"Our View: With Nevada Sen. Harry Reid in the Senate majority leader's office. It will be nearly impossible to overcome the state's opposition"

The long term

The plan to store the nation's nuclear waste in the Yucca Mountain Repository is not sustainable.

An Associated Press article in RGJ on August 4, 2006 stated: "Currently, there are more than 50,000 tons of nuclear waste piled up at commercial nuclear power plants in 31 states.

The administration wants to lift the 77,000-ton storage cap on the dump 90 miles northwest of Las Vegas and allow as much waste as the mountain can safely hold--132,000 tons or more".

During a hearing before the House Committee on Science, Energy Subcommittee, Hearing on Nuclear Fuel Processing—June 16, 2005, Dr. Phillip Finck from the Argonne National Laboratory, states "At that Projected nuclear growth rate, (1.8% per year) the U.S. will need up to nine Yucca Mountain-type repositories by the end of this century".

New Technology

With today's available technologies, and employing advanced fuel cycles, future U.S. plants will be able to process spent nuclear fuel (SNF) to a level it will be virtually free of radiotoxic elements and with no liquid wastes requiring underground tank storage.

This is the subject of many projects at various DOE facilities such as the Argonne National Laboratory, (ANL) the Idaho National Laboratory, (INL) and Savannah River Site (SRS).Some of these programs are the Advanced Fuel Cycle Initiative (AFCI), and the Gen-IV programs for next generation nuclear reactors, and the Global Nuclear Energy Partnership (GNEP)

What is nuclear fuel?

Nuclear fuel for the thermal nuclear power reactors used in the United States starts out with refined uranium. It contains 99.3% uranium (U-238), and 0.7% Uranium (U- 235) which is the only part of the fuel that is fissile. In order to sustain a chain reaction in the reactor the refined uranium must be enriched until it contains a little over 4% uranium (U235).

When an atom of U-235 cleaves it releases two or three energetic neutrons. In order for the process to continue the neutrons must be slowed down so they can be captured by another U235 atom. It's like trying to grab a five dollar bill on a windy day. The water in the reactor core acts a moderator and slows the neutrons down. Reactors that rely on slow neutrons are referred to as Thermal Reactors.

Since the fuel only goes through the reactor once, the process is referred to as the Once-through Fuel Cycle.

One very undesirable feature of this process is that in order to get one kilo of usable fuel, 6 to 10 kilos of uranium are wasted and thrown out as tailings or as low level nuclear waste. None of the existing Slow Neutron (Thermal Reactors)can utilize this wasted uranium, but the next generation (GEN IV) Fast Neutron (Fast Reactors) will be able to utilize 100 % of it.

What is spent nuclear fuel?

After the fuel is burned the fuel rods are removed from the reactor core, and they become a waste product known as spent nuclear fuel (SNF) It has the following composition:

93% Uranium. Mostly U238 and some unburned U235.

1% Plutonium. A slow neutron or a so called Thermal Neutron Reactor is also a breeder reactor and it makes plutonium, which in turn creates additional energy as a secondary source of fuel. Plutonium from SNF is sometimes referred to as "Reactor-grade Plutonium". It is very different from highly refined (90% +) "Weapon-grade Plutonium". About two thirds of reactor plutonium is Pu239. Plutonium has many isotopes, which can act as contaminates, but it can also act as a barrier to nuclear proliferation.

1% Minor actinides.

Neptunium Np237,

Americium Am241,

Curium Cm244

These elements are very radioactive and release a lot of heat.

5% Fission products. This is the true nuclear waste. It is composed of many elements that are created during the fission process.

When SNF is to be stored or recycled, four elements are of concern and can cause future problems.

Cesium Cs137 and **Strontium Sr90**, Both of these elements have a half life of about 30 years and generate a lot of heat. The heat is a major problem if these elements are stored underground in a repository along with other nuclear waste products.

Iodine I129 which has a half life of 15,700,000 years.

Technetium Tc98 with a half life of 4,200,000 years.

Both of these elements are radioactive and can create problems with the future disposal of fission products. These elements do have commercial value as radioactive tracers. For instance, there are over 40 pharmaceuticals that are made from technetium. These elements can also be eliminated by a process called transmutation. Transmutation converts the long life elements into other combinations of elements that have a shorter half-life. This would facilitate a convenient disposal strategy for combination with other fission products.

The Solution

FIRST:

The first thing that needs to be accomplished is to completely terminate the entire Yucca Mountain Repository program.

The requirement to dispose of high level nuclear waste in an underground repository was a logical choice 30 years ago, but with recycling technology and the large volumn of spent nuclear fuel (SNF) that has been created and stored on the nuclear power sites today, a deep geological repository is not sustainable. It can not work in the future and doesn't work now. There is no reason to store very toxic radioactive nuclear waste products 1,000 feet underground when, with today's technology, the high-level waste products can be recycled and processed untill they are no longer harmful.

About 95% of the SNF is spent uranium. Since uranium can be burned as a fuel in future generation Fast Spectrum Reactors, an underground repository prevents a valuable resource from ever being used in the future.

Uranium is cheap now, but with the future resurgence of Nuclear Energy the price of uranium fuel will escalate as future demand exceeds the available supply.

THERE IS TIME

Spent nuclear fuel is being stored in pools under 10 feet of water at the nuclear power station sites. Many of the sites have run out of storage space, so they are storing the SNF in specially designed dry casks that have been certified by NRC.

NRC has stated that the dry casks are safe for 30 years beyond the reactor life. That means that SNF can be stored on site for 100 years.

There is time to find a safe and a better solution for the disposal of nuclear waste.

THE WASTE PROBLEM IS GOING TO GET WORSE:

With the resurgence of nuclear power programs it appears that a lot more SNF is going to be created.

Dr. Nils J. Diaz, chairman of the Nuclear Regulatory Commission, Submitted a statement on June 22, 2006, detailing the oversight of their review of 25 power plant applications to be located on 18 locations in the United States

Eleven of these applications are for the Westinghouse AP 1000 power plants that are 1,117-MW.

Three of the applications are for the G.E. ESBRW (Economic Simplified Boiling Water Reactor) power plants which are 1,500-MW.

Four of applications are for the G.E. ABWR (Advanced Boiling Water Reactors) which are 1,315-MW.

Five of the applications were for AREVA"s U.S. EPR which is a 1,600-MW pressurized water reactor.

Two of the designs were unspecified.

These new plants are GEN III Simplified, Modular Reactors. They are slow neutron (Thermal Neutron) type reactors designed to use the once-through uranium cycle. They can utilize only a fraction of one percent of the uranium fuel that is refined for reactor fuel. All of them are large plants. They will add a substantial amount of spent nuclear fuel to the existing inventory.

A 1,000-MW plant will generate 100 tons of spent fuel a year.

It is anticipated that the new reactors will have a life span of 60 years.

At the present time the 103 nuclear power reactors in the United States are generating about 2,000 tons of high level nuclear waste annually.

THE NEXT STEP

For the next budget year, DOE needs to place more resources into reprocessing and recycling. France, UK, and Russia have been recycling SNF for over 30 years. The United States under Jimmy Carter banned it in 1977.

If the Yucca Mountain project were to be terminated, the DOE would have additional financial resources to shorten the development time for recycling and reprocessing facilities, and shorten the time when the new GEN IV fast spectrum reactors could begin adding to, or replacing the existing older reactors.

THE RECYCLING PROCESS

The recycling process, as planned, is taking way too long. Designers today have a world of new tools which integrate 3 D graphics, and data exchange systems into engineering design software. This new innovative engineering software is used to design new power plants like the Westinghouse AP 1000, which has been approved by NRC.

GE built two 1,350-MW ABWRs in Japan in just 39 months.

Westinghouse, not to be out done, claims that their new AP1000 can be built in three years.

THE FIRST PROCESS: UREX+, and MOX

The UREX+ process extracts pure uranium from the SNF and combines it with mix of plutonium and some transuranics to create a new fuel called MOX (uranium oxide mix).

The remaining fission products would be refined by removing strontium, cesium, iodine, and technetium.

The refined fission products could be economically stored in shielded containers above ground in concrete bunkers for 100 to 500 years. At that time they would become harmless, and could be buried in a land fill, without any special handling.

The UREX+ process is being developed at Idaho National Laboratory INL. It may take 10 years before this process could be ready for commercial plant design and construction.

The first MOX plant in the U.S. is at the Savanna River Site (SVS). It is an Americanized version of a similar plant in France and is being built specifically to recycle weapon grade plutonium that has accumulated at SVS.

The design and construction of a MOX plant including a Fuel Fabrication Facility (FFF) that could specifically process SNF, could probably be achieved before the first UREX+ plant could be built.

The main goal of recycling program should be to slow down the stream of enriched uranium fuel that is being supplied to the nuclear power plants, which in turn also reduces the amount of SNF that is being generated.

All the new reactors and some of the older reactors like the three reactors at the Palo Verde Nuclear Generating Station in downtown Phoenix can be run on 100% MOX fuel, and many of the older reactors can utilize the MOX fuel for a third of the fuel in the core.

All the new advanced Generation III+ reactors can burn MOX fuels.

A recycling program using the UREX+ and MOX process would take 25 to 50 years to recycle all the existing SNF that is now stored under water or in dry casks at the existing power plant locations.

It is likely that the MOX fuels would not be recycled again because of the buildup of the highly radioactive and unstable actinides. This spent nuclear MOX fuel would require a different reprocessing system called pyroprocessing.

THE SECOND PROCESS;

PYROPROCESSING AND THE INTEGRAL FAST REACTOR

This program is under development at Argonne National Laboratory (ANL). It is called the Pyrometallurgical Process. It extracts uranium, plutonium and the actinides by electrorefining in a high temperature chemical bath. The end products are all kept together in a metallic state and than sent to a fuel fabrication facility where they are cast into new fuel rods.

The recycled fuel is then burned in an advanced fast neutron reactor. This reactor is called an (ALMR) Advanced Liquid Metal Reactor. It is a sodium cooled fast spectrum reactor that could be called a "**nuclear garbage burner**". It burns uranium, plutonium and the associated actinides.

The fission products are extracted from the chemical bath, vitrified with glass, and prepared for temporary storage until they become harmless and can be placed in a permanent land fill.

THE CLOSED CYCLE

It is most important that all processes be at one site. That is the UREX+ facility, the MOX plant, the fuel fabrication facility (FFF) the pyroprocessing plant, the ALMA reactor and the temporary storage site for the refined fission products. This would constitute a closed cycle.

A closed cycle eliminates the problems of transporting radioactive materials between plant locations.

More information about Pyroprocessing can be obtained by referring to an article in the December 2005 issue of Scientific American titled "**Smarter Use of Nuclear Waste**" by William H. Hannum, Gerald E. Marsh, and George S. Stanford. The authors are retired physicists from Argonne National Laboratory.

SUMMARY

There is enough spent uranium and reactor plutonium being stored at reactor power plant sites in the U.S. along with all the wasted uranium from the enrichment operations to supply reactor fuel for the all the future nuclear power plants in the United States for hundreds and hundreds of years.

Congress should pass legislation declaring that all the available uranium and plutonium should be protected and properly stored for the future of nuclear power world wide.

The fuels should be declared a **Strategic Global Resource**. This could be coordinated by the Global Nuclear Energy Partnership (GNEP) program.

The future resurgence of nuclear energy would be a clean source of electrical power that could eventually replace over a thousand existing coal fired power plants. This would require an adequate supply of recycled uranium fuel and the introduction of the new GEN IV fast spectrum reactors that can burn 100 percent of the uranium fuel instead of just a fraction of one percent with the remaining 99% becoming nuclear waste.

The existing research and experimental programs may need to have additional funding to meet shorter time schedules, and to speed up the design and construction of new recycling and reprocessing facilities.

The new facilities along with new generation (GEN IV) fast reactors is the only way the existing stockpile of spent nuclear fuel can be safely recycled, reprocessed ,or stored until it becomes harmless and safe to handle without special procedures.