EDO Principal Correspondence Control

FROM: DUE: / / EDO CONTROL: G20090641
DOC DT: 10/26/09
FINAL REPLY:

Robert Steinhaus
Castro Valley, California

TO:

Chairman Jaczko

FOR SIGNATURE OF : ** GRN ** CRC NO: 09-0540

DESC:

Underground Nuclear Reactor Mounting - Change NRC Regulations to Permit Better Security
(EDATS: SECY-2009-0492)

ROUTING:

Borchardt
Virgilio
Mallett
Ash
Mamish
Burns/Gray
Bagley, OEDO

DATE: 11/04/09

ASSIGNED TO: CONTACT:

NSIR Wiggins

SPECIAL INSTRUCTIONS OR REMARKS:

For Appropriate Action.

Template: SECY-017

E-RIDS: SECY-01

EDATS
Electronic Document and Action Tracking System

EDATS Number: SECY-2009-0492 **Source:** SECY

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Other Assignees:	**SECY Due Date:** NONE
Subject: Underground Nuclear Reactor Mounting - Change NRC Regulations to Permit Better Security in Case of War on Terrorist Attack and Potentially Save 100,000 American Lives per Incident	
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ADAMS Accession Numbers - Incoming: NONE	**Response/Package:** NONE

Other Information	
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Related Task:	**Recurring Item:** NO
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	Sensitivity: None
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OEDO Concurrence: NO	
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Special Instructions: For Appropriate Action.	

Document Information	
Originator Name: Robert Steinhaus	**Date of Incoming:** 10/26/2009
Originating Organization: Citizens	**Document Received by SECY Date:** 11/4/2009
Addressee: Chairman Jaczko	**Date Response Requested by Originator:** NONE
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OFFICE OF THE SECRETARY
CORRESPONDENCE CONTROL TICKET

Date Printed: Nov 04, 2009 09:20

PAPER NUMBER:	LTR-09-0540	**LOGGING DATE:**	11/02/2009
ACTION OFFICE:	EDO		

AUTHOR:	Robert Steinhaus
AFFILIATION:	CA
ADDRESSEE:	Gregory Jaczko
SUBJECT:	Underground nuclear reactor mounting---change NRC regulations to permit better security in case of war or terrorist attack
ACTION:	Appropriate
DISTRIBUTION:	Chairman, Comrs
LETTER DATE:	10/26/2009
ACKNOWLEDGED	No
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FILE LOCATION:	ADAMS

DATE DUE:		**DATE SIGNED:**	

EDO --G20090641

Robert Steinhaus
18920 Thornbury Ave.
Castro Valley, CA 94546-3141

October 26, 2009

The Honorable Gregory B. Jaczko
Commissioner US Nuclear Regulatory Commission
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Underground Nuclear Reactor Mounting - Change NRC Regulations to Permit Better Security in case of War or Terrorist Attack and Potentially Save 100,000 American Lives per Incident

Dear Commissioner Jaczko:

I am a retired Lawrence Livermore National Laboratory staff member who would like to quickly mention a security worry that Homeland Security may have long since exhaustively analyzed and designed security responses for but for good reasons may have not announced to the general public.

Nuclear Reactors have a much higher (typically > 100X+) inventory of Uranium, Plutonium, and fission products than typical nuclear weapons. Spent nuclear fuel is currently stored locally near operating reactors and typically in above ground dry casks. The above ground local storage of spent nuclear fuel rods adds quite significantly to the inventory of nuclear materials stored near the reactor and in many instances may exceed by many times the inventory of fission products produced in fallout from a nuclear weapon. If a nuclear weapon was detonated at the surface in the vicinity of a reactor in a precision strike right at the location of a commercial reactor and its dry cask spent fuel storage it would scatter and suspend in the atmosphere a large amount of radioactive fission products and Minor Actinide contaminants. A nuclear explosion occurring at or near the earth's surface can result in severe contamination by the radioactive fallout. A 15-megaton thermonuclear device tested at Bikini Atoll on March 1, 1954—the BRAVO shot of Operation CASTLE produced fallout resulting in substantial contamination over an area of more than 7,000 square miles. The contaminated region extended more than 20 statute miles upwind and over 350 miles downwind. The magnitude of the radioactive material suspended from nuking a reactor and its local SNF storage from a precision surface detonation right at the location of the SNF storage would surely amplify by many times the distribution of dangerous fallout over the detonation of the weapon alone. This might make targeting an above ground reactor and local SNF storage located near a city a kind of double threat target for a hostile nation or advanced terrorist organization (destroy power infrastructure + produce a surface EMP pulse that would couple into the reactor grid infrastructure + increased lethality from SNF storage fallout associated with blast).

NRC currently does not authorize underground mounting as an approved reactor mounting method for new nuclear reactors but permitting underground mounting of nuclear reactors could improve the safety of communities living near nuclear reactors and complicate a terrorist's or rouge state's problems in precisely targeting a reactor and its associated local SNF storage with a weapon. There is currently a new group of approximately 30 reactors pending NRC license.

Why not rewrite NRC regulations to make it possible for communities to underground mounting of their new nuclear reactors and also suggest best practice underground sequestration of SNF to achieve better target hardening and security?

Dr. Edward Teller [1] suggested mounting new nuclear reactors underground in part to harden reactors to terrorist or war threats. Mounting reactors at least 10 meters underground would greatly reduce the chance that a precision targeted surface detonated nuclear weapon would suspend large amounts of additional material from an operating reactor and even more significantly from the local recently stored SNF in dry casks.

Thank you for your kind consideration.

Sincerely, Robert Steinhaus

Robert Steinhaus

Phone: 510-581-8193
Email: steinhausq@yahoo.com

[1] Dr. Edward Teller, the founding director of the Lawrence Livermore National Laboratory, wrote his final paper a month before his death on the subject of the advantages of underground mounting of nuclear Reactors.
http://www.geocities.com/rmoir2003/moir_teller.pdf

THORIUM-FUELED UNDERGROUND POWER PLANT BASED ON MOLTEN SALT TECHNOLOGY

FISSION REACTORS

TECHNICAL NOTE

KEYWORDS: *molten salt reactor, thorium, underground*

RALPH W. MOIR* and EDWARD TELLER†
Lawrence Livermore National Laboratory, P.O. Box 808, L-637
Livermore, California 94551

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This paper addresses the problems posed by running out of oil and gas supplies and the environmental problems that are due to greenhouse gases by suggesting the use of the energy available in the resource thorium, which is much more plentiful than the conventional nuclear fuel uranium. We propose the burning of this thorium dissolved as a fluoride in molten salt in the minimum viscosity mixture of LiF and BeF_2 together with a small amount of ^{235}U or plutonium fluoride to initiate the process to be located at least 10 m underground. The fission products could be stored at the same underground location. With graphite replacement or new cores and with the liquid fuel transferred to the new cores periodically, the power plant could operate for up to 200 yr with no transport of fissile material to the reactor or of wastes from the reactor during this period. Advantages that include utilization of an abundant fuel, inaccessibility of that fuel to terrorists or for diversion to weapons use, together with good economics and safety features such as an underground location will diminish public concerns. We call for the construction of a small prototype thorium-burning reactor.

I. POWER PLANT DESIGN

This paper brings together many known ideas for nuclear power plants. We propose a new combination including nonproliferation features, undergrounding, limited separations, and long-term, but temporary, storage of reactor products also underground. All these ideas are intended to make the plant economical, resistant to terrorist activities, and conserve resources in order to be available to greatly expand nuclear power if needed as envisioned by Generation IV reactor requirements.

We propose the adoption of the molten salt thorium reactor that uses flowing molten salt both as the fuel carrier and as a coolant. The inventors of the molten salt reactor were E. S. Bettis and R. C. Briant, and the development was carried out by many people under the direction of A. Weinberg at Oak Ridge National Laboratory.[1] The present version of this reactor is based on the Molten Salt Reactor Experiment[2–4] that operated between 1965 and 1969 at Oak Ridge National Laboratory at 7-MW(thermal) power level and is shown in Fig. 1. The solvent molten salt is lithium fluoride (LiF, ~70 mol%) mixed with beryllium fluoride (BeF_2, 20%), in which thorium fluoride (ThF_4, 8%) and uranium fluorides are dissolved (1% as ^{238}U and 0.2% as ^{235}U in the form of UF_4 and UF_3, $UF_3/UF_4 \geq 0.025$).[a] This mixture is pumped into the reactor at a temperature of ~560°C and is heated up by fission reactions to 700°C by the time it leaves the reactor core, always near or at atmospheric pressure. The materials for the vessel, piping, pumps, and heat exchangers are made of a nickel alloy.[5,6][b] The vapor pressure of the molten salt at the temperatures of interest is very low ($<10^{-4}$ atm), and the projected boiling point at atmospheric pressure is very high (~1400°C). This heat is transferred by a heat exchanger to a nonradioactive molten fluoride salt coolant[c] with an inlet temperature of 450°C and the outlet liquid temperature of 620°C that is pumped to the conventional electricity-producing part of the power plant located aboveground. This heat is converted to electricity in a modern steam power plant at an efficiency of ~43%.

The fluid circulates at a moderate speed of 0.5 m/s in 5-cm-diam channels amounting to between 10 and 20% of the volume within graphite blocks of a total height of a few meters.

*E-mail: Moir1@llnl.gov
†We are sorry to inform our readers that Edward Teller is deceased September 9, 2003.

[a] Instead of the Be and Li combination, we might consider sodium and zirconium fluorides in some applications to reduce hazards of Be and tritium production from lithium.

[b] It seems likely all these components could be made of composite carbon-based materials instead of nickel alloy that would allow raising the operating temperature so that a direct cycle helium turbine could be used rather than a steam cycle (~900°C) and hydrogen could be made in a thermochemical cycle (~1050°C). A modest size research and development program should be able to establish the feasibility of these high-temperature applications.

[c] A secondary coolant option is the molten salt, sodium fluoroborate, which is a mixture of $NaBF_4$ and NaF. Other coolants are possible depending on design requirements such as low melting temperature to avoid freeze-up.

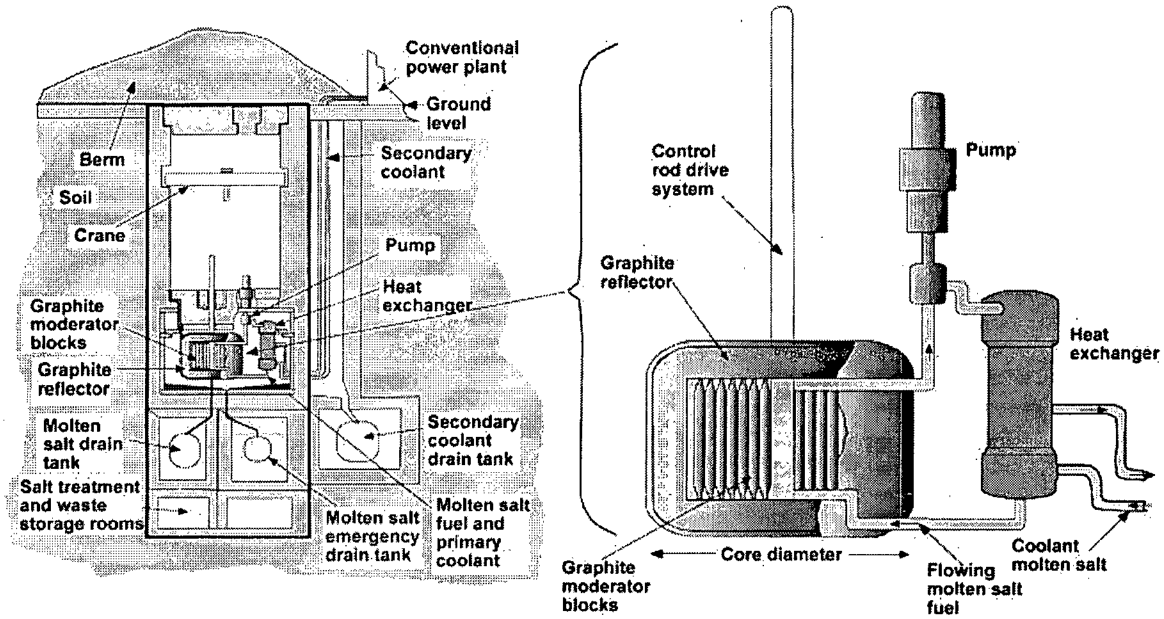

Fig. 1. The nuclear part of the molten salt power plant[7] is illustrated belowground with the nonradioactive conventional part aboveground; many rooms and components are not shown. New cores would be installed after each continuous operating period of possibly 30 yr or the graphite in the cores can be replaced.

Of all these components, only graphite can burn and then slowly. Leakage of air or water into the molten salt is to be minimized to limit corrosion, as oxidation rates are low. In case of an accident, the fuel would be isolated from the graphite by passively draining the molten salt to the drain tank thus removing the decay heat source making the graphite hot.

The graphite slows down the fast neutrons produced by the fission reaction. The slowed neutrons produce fission and another generation of neutrons to sustain the chain reaction. One of the slowed neutrons is absorbed in ^{232}Th producing ^{233}Th, which undergoes a 22-min beta decay to ^{233}Pa. The ^{233}Pa undergoes a month-long beta decay into ^{233}U, which with a further neutron produces fission and repeats the cycle. The reactions are illustrated in Fig. 2. Note that the cycle does not include ^{235}U, which is used only to initiate the process. The result is a drastic reduction of the need for mined uranium.

The initial fuel to start up the reactor can be mined and enriched ^{235}U [~3500 kg for 1000 MW(electric)]. An alternative

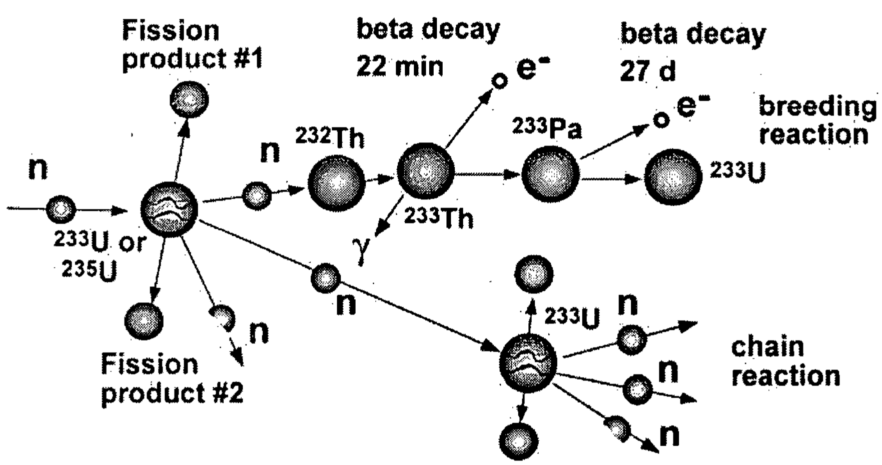

Fig. 2. Illustration of the process of breeding or producing new fuel, ^{233}U, from neutron capture in ^{232}Th as a part of the chain reaction. Each fission reaction produces two or three neutrons (about 2.5 on average as illustrated by the "half neutron" above).