

# How to deal with spent fuel fires

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# An intractable problem

*In 1952, four years before the United States began commercial generation of electricity by nuclear fission, James Conant – Roosevelt's wartime advisor on atomic energy and later president of Harvard University – predicted that the world would turn away from nuclear power because the problem of waste disposal would prove intractable.*

*– Burying Uncertainty, K.S. Shrader-Frechette, 1993*

# Why worry?

Baltimore Tunnel Fire, July 18<sup>th</sup>, 2001.

*Peak fire temperature estimate during the five day fire was “at least 1000° F to 1500° F”*

*NRC regulations require that a dry storage cask must only survive an engulfing 1,475° F fire for 30 minutes...*

# Evacuation?

The accident occurred on the designated route for removing Calvert Cliffs' spent fuel to Yucca Mountain. The local fire department was not alerted for 60 minutes. There goes much of the needed evacuation time!

*A tunnel accident involving spent fuel (ONE cask) could have caused 5,000 to 15,000 latent fatal cancers (among Baltimore residents) over the next 50 years, and cost nearly \$14 BILLION to remediate.*

– Lamb & Resnikoff, RWMA, Sept 2001



# Why use dry casks?

1. Originally, fuel was ONLY supposed to be stored on site for a few months... the reason was weapons, of course – the Pu239 becomes Pu240 if you wait, and that's no good for bombs... Or reactors...
2. No Yucca Mtn.
3. "Trouble with a capital T that rhymes with P and stands for pool." – Elliott Negin, UCS

# Unsound Logic:

**“Plant owners eventually will have to transfer spent fuel to dry casks to ship it via rail or truck to an interim or permanent repository, so it makes the most sense to accelerate the transfer to the less vulnerable dry casks.”**

**– Elliott Negin, UCS, Huffington Post June 2012**

**But does it really make sense to do those extra transfers? What about shutdown since the problem is “intractable”? Has “intractable” changed meanings since 1952?**

# What is a dry cask?

They're about 20 feet tall, 10 feet in diameter, and weight about 100 tons, including about 15 tons of used reactor core assemblies within it.

Dry casks are filled with an inert gas, usually helium. At least one reason is to keep water out of them (water vapor). They don't want things rusting, since no one's looking... for 40, 60, 100, 200, even 300 years... guarding them will become a family business for generations to come... so will fabricating them...

# What are they made of?

Dry casks are made of steel, lead and cement to protect from gamma rays.

Additionally, polyethylene, more concrete and boron-impregnated metals or resins are used to shield neutrons. The fuel is separated by “baskets” inside the dry cask, and each dry cask must be separated from other dry casks by some distance, because so-called “spent” fuel can have a *criticality event* if you’re not careful.



# How can that happen?

For a criticality event, spent fuel from Light Water Reactors (such as both US reactor designs) needs a “moderator” – normally water – to slow the neutrons. Water intrusion into a dry cask is possible a number of ways, such as, for San Onofre, a tsunami.

One dry cask may not have enough material for a criticality event under most circumstances, but these things are never alone. There are currently over 1,400 dry casks in America, with more added every week.

# Things to worry about:

Airplane strikes, terrorists, manufacturing errors, abandonment, earthquakes, tsunamis, "tornado missiles"... "Skylab", asteroids...

"There have also been no known or suspected attempts to sabotage spent fuel casks or storage facilities." – NRC

Does that mean there never will be?

# Security is warm gun, yeah!

"Dry casks were designed to ensure safe storage of spent fuel, not to resist terrorist attacks.... the protection requirements for these installations are lower than those for reactors and spent fuel pools. The guard force is required to carry side arms, and its main function is surveillance: to detect and assess threats and to summon reinforcements... The protected area is surrounded by vehicle barriers to protect against the detonation of a design basis threat vehicle bomb...." (nap.edu 2006)

# More things to worry about:

"In general, the analyses show that some types of [aircraft] impacts will damage some types of casks. For some scenarios there could be substantial cask-to-cask interactions, including collisions and partial tipovers" ... but at least Sandia Labs concluded that jet fuel would likely be dispersed over a large area in a low-angle impact... Long-duration fires that could damage the casks or even ignite the cladding of the spent fuel were not seen to be credible for the aircraft impact scenarios considered by Sandia.



# But...

**Sandia Labs evidently doesn't know you can barrel-roll a jet airliner of any size... at the top of the roll you can pull back on the controls and you'll dive just like a Stuka... it's a "1-g" maneuver – you just can't pull out.**

**... and you can practice this maneuver over and over in the comfort of your own home!**

# What, me worry?

**“Additional surveillance could be added to dry cask storage facilities to detect and thwart ground attacks. Certain types of cask systems could be protected against aircraft strikes by partial earthen berms. Such berms also would deflect the blasts from vehicle bombs. Visual barriers could be placed around storage pads to prevent targeting of individual casks by aircraft or standoff weapons. These would have to be designed so that they would not trap jet fuel in the event of an aircraft attack.”**

# Safer than pools?

- 1) There is less fuel in a dry cask – that's nice.
- 2) Measured on a per-fuel-assembly basis, the inventories of radionuclides available for release from a dry cask are lower than those from a spent fuel pool because dry casks store older, lower decay-heat fuel.
- 3) “It is the potential for zirconium cladding fires in spent fuel pools that gives dry cask storage most of its comparative safety and security advantage.”

– nap.edu 2006

# Dry casks add to the risk:

"All storage cask designs are vulnerable to some types of terrorist attacks for which radionuclide releases would be possible."

"Dry cask storage does not eliminate the need for pool storage at operating commercial reactors."

– nap.edu 2006

So it's not one or the other. It's both...



# How risk is calculated:

1. The scenario describing the undesirable event,
2. The probability that the scenario will occur,
3. The consequences if the scenario should occur.

– nap.edu 2006

## In other words...

# How risk is really calculated:

*Like an old Ford Pinto...*

**“The committee expects that cost-benefit considerations would be a part of these analyses.”**

-- nap.edu 2006

# Worst-case scenario:

**“The maximum credible scenario for suicide attacks involving civilian passenger aircraft would utilize the largest civilian passenger aircraft widely used in the United States flying at maximum cruising speed and hitting the facility at its most vulnerable point.”**

**– *nap.edu* 2006**

***BUT REALLY, THEY DECIDED THE PLANE WOULD CRASH "JUST SO". It's further assumed terrorists cannot get access to military aircraft or "bunker busters" and, of course, can't get hold of a nuclear weapon!!! (Let's hope they're right.)***

# **“Reasonable” terrorists?**

**“[Nuclear] weapons would be relatively difficult for terrorists to build or steal. Even if such a weapon could be obtained, the committee can think of no reason that it would be used against a spent fuel storage facility rather than another target. There are easier ways to attack spent fuel storage facilities, as discussed in the classified report, and there are more attractive targets for nuclear weapons, for example, large population centers.”**

**– *nap.edu* 2006**



# What they really worry about is damage to their industry:

“Attacks using rocket-propelled grenades (RPGs) of the type that have been carried out in Iraq against U.S. and coalition forces would not likely be successful if the intent of the attack is to cause substantial damage to the facility. Of course, such an attack would get the public’s attention and might even have economic consequences for the attacked plant and possibly the entire commercial nuclear power industry.”

– *nap.edu 2006*

# Don't think it can't happen:

**“The committee judges that it is not prudent to dismiss nuclear plants, including their spent fuel storage facilities, as undesirable targets for attacks by terrorists ... Attacks by knowledgeable terrorists with access to advanced weapons might cause considerable physical damage to a spent fuel storage facility, especially in a suicide attack.”**

**– *nap.edu* 2006**

# Too much of a bad thing:

In 1980 it was estimated that the annual production of plutonium exceeded that of platinum. The total volume of nuclear waste is sometimes described as fitting on a football field 7 yards deep if consolidated.\* Of course, it would go critical if you tried to do that! But that's actually more than all the gold ever extracted.

The important thing is to stop making more waste. There's no such thing as a good solution to an intractable problem.

\* (industry only) [nei.org](http://nei.org) 2012

# Final thoughts:

Extracting Pu-239 and U-235 through “reprocessing” does not destroy the fission products. It is horribly polluting and prohibitively expensive. Transmutation is energy-intensive, incomplete, and technologically challenging to what extent it can be done at all. Other methods of spent fuel “burn-up” are likewise foolhardy.

We don't need a new definition of “intractable”.

We need to stop making more nuclear waste.