PROPOSED OFFSITE ISFSI LOCATION IN CALIFORNIA

V1.0 August 24, 2015
V1.1 June 06, 2016 -- See last paragraph of conclusion
V1.2 March 2, 2017 -- Added information about nearby volcanism, Amboy Crater.

A proposal by Citizens' Oversight to increase public safety
CitizensOversight.org

Introduction

Moving the spent nuclear fuel away from San Onofre is essential to minimize our overall risk. But where to put it? Keeping it in California can minimize hoops to jump through, and can allow us to limit the spent fuel sent there to fuel from closed nuclear plants in California, and then not become a dumping area for all nuclear fuel in the multistate area. No matter where it is, many issues will have to be dealt with and those things will take at least two to ten years. But now is the time to start the process. This site is only put forward as an attempt to get the conversation started rather than a conclusion that this is the only and best site. Providing an off-site ISFSI location to avoid risks at closed plants must not become a green light to installing new nuclear plants.

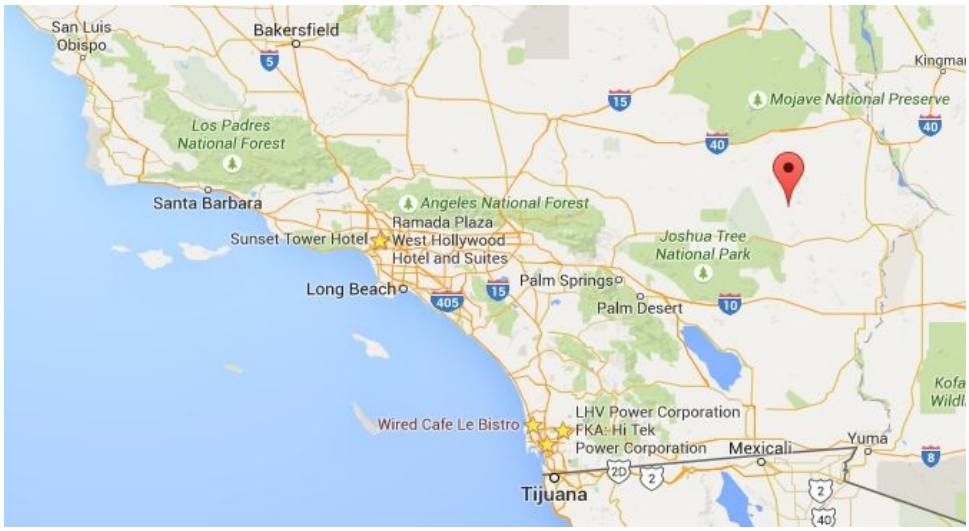
Our proposal: near Fishel, CA 92277 (San Bernardino County)
Link to the map: https://goo.gl/maps/Z5Uzb

Key features:

- Population: 0
- Nearest improved property: >13 miles away (water pumping plant)
- Nearest private improved property: Cadiz ~20 miles away.
- Nearest larger cities: >50 miles away (Lake Havasu, Colorado River)
  - Twentynine Palms is about 47 miles from the site, three mountain ranges away.
  - Twentynine Palms/Yucca Valley and Needles are the minor civil divisions. They border on the ARZC railroad line.
- On the Arizona and California (ARZC) railroad about 21 miles from Cadiz where it connects to the BNSF railroad
- Total distance from Barstow BNSF switchyard is 100 miles to Cadiz, then 21 miles to Fishel.
- Near a road (Cadiz Road).
- On the North American Plate (earthquakes unlikely). Not on the moving Pacific Plate.
- Not close to any fault lines (See map below)
- Away from salty ocean air (chloride induced stress corrosion cracking less likely)
- Away from densely populated areas (>8.4 million near San Onofre)
- No Tsunami Risk (however flash flood risk must be evaluated)
- No mega freeway nearby (as we have at San Onofre). I-10 and I-40 are 40 and 33 miles away as the crow flies. By road, it is about 55 miles from I-10 (Desert Center) by road, and 65 miles from I-40 at Ludow.
- Political representation: California’s 8th congressional district. Paul Cook, a Republican from Yucca Valley, has represented the district since January 2013.
- Very hot and dry with very little degradation over time due to the environment.
- Downside: hot air does not allow canisters to cool as well as a coastal environment.

Fishel is a spot on the map that has a name because it is a spot along a railroad line, but nothing is there. If this spot is not perfect, is there not another place in this vicinity that would work?

Here is a big-picture view of the location. It is roughly halfway between I-10 and I-40.



If we look at this location from satellite imagery, we see it is in perhaps one of the most desolate and unused portions of the state. This area is not in a preserve or wilderness area.

As we look closer, we see the “town” of Fishel is just a spot on the map rather than a place where anyone lives.

As we look north up this valley, which is called “Ironwood Wash” we see the darker areas to the east are the Turtle Mountains. It may be better to site the ISFSI in the harder rock of these mountains rather than in the wash but more research would be required to determine this. The foothills of those mountains are about 2 miles away. There are also other places along the railroad line that may be better but for discussion, we will assume somewhere near Fishel is the spot.

At about the same magnification looking straight down, as can see that the marker is near a road and railroad tracks.

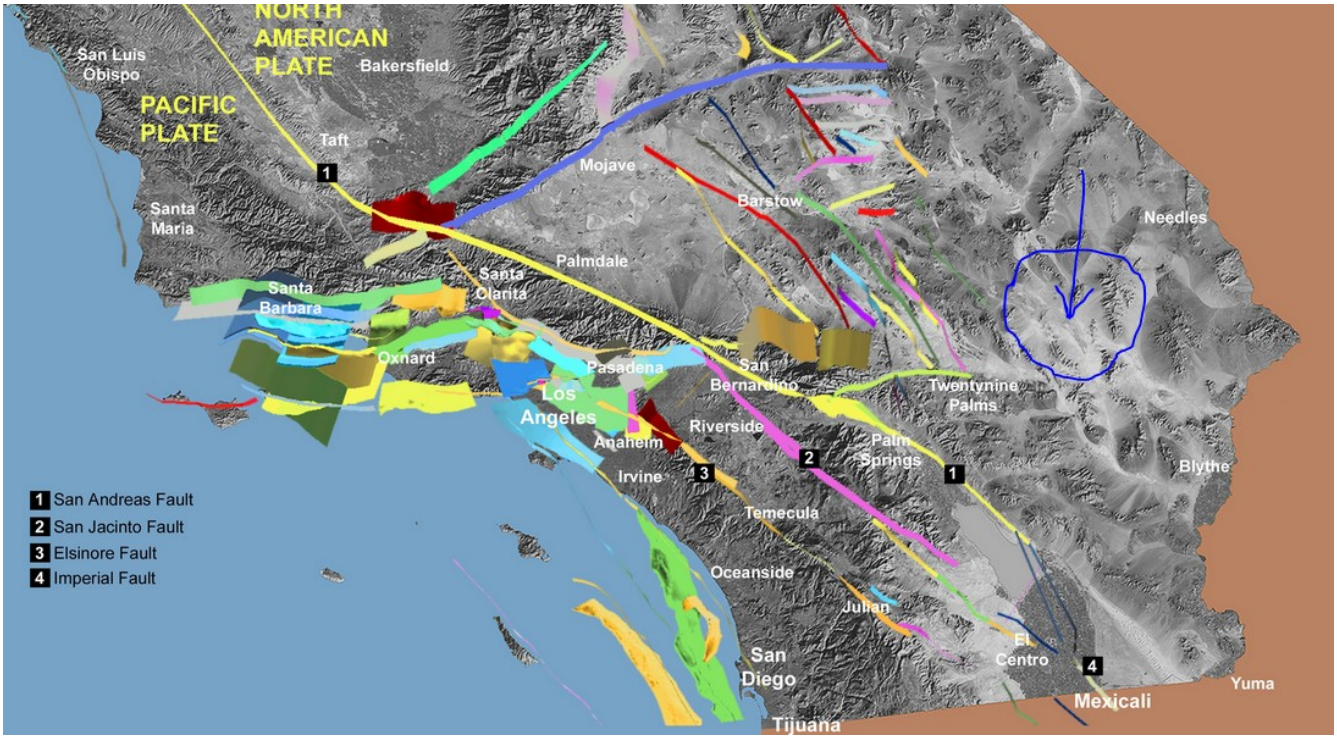
As we zoom in a bit more, we can more clearly see that there is a road here, Cadiz Road, and a set of railroad tracks. This is the Arizona and California line which apparently is still used and in good repair.

The nearest improved property is the Iron Mtn Pumping Station which pumps water over the mountain toward San Diego from the Lake Havasu area of the Colorado River, over 13 miles away (as the crow flies).

This pumping station is not the sole source of water for San Diego County, but does provide a significant percent. Its source water comes from the Colorado River about 10 miles south of Lake Havasu City. This plant and the surrounding area was chiefly developed during the depression era and built by the CCC.

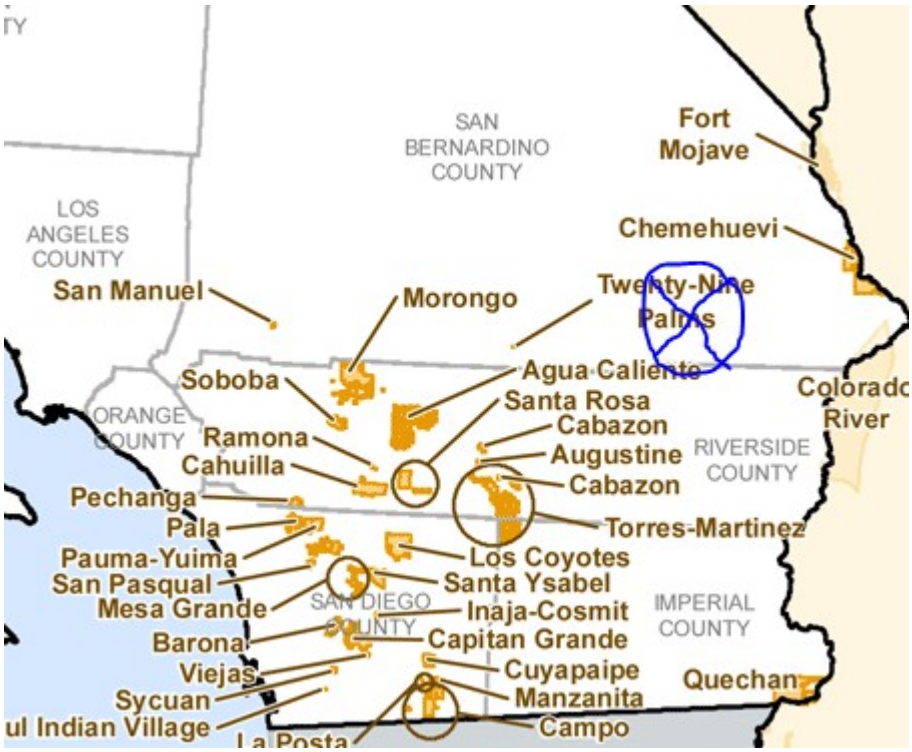
Seismic

There are no major fault lines in this area. The USGS lists no hazards except for extreme heat.



Proximity to Tribal Areas

We note also that this is not a tribal reservation area, so there may be few cultural resource issues here, although the entire area is certainly a region once used by Native American tribes. It is also the habitat of the desert tortoise.



Not a Designated Wilderness

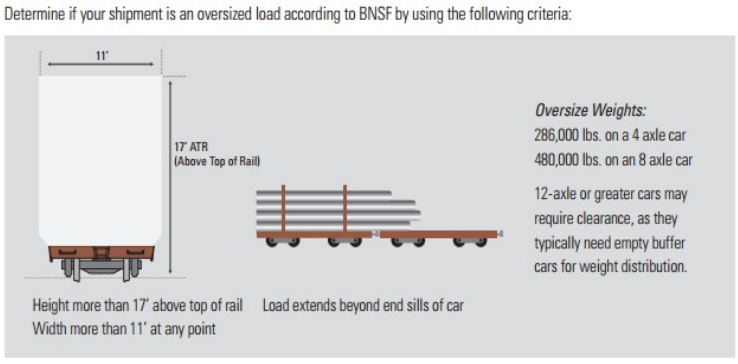
As mentioned, it is not in a designated wilderness area, and is mostly land owned by the government.

Excellent Railroad Access

The site is about 120 miles from Barstow railroad switch yard, operated by BNSF. That includes about 100 miles on improved and active BNSF track to Cadiz and about 21 miles on the Arizona and California ARZC railway to Fishel. (Still investigating if this 21 mile spur would need to be improved.) The exact location of the Off-Site ISFSI would be probably +/- 10 miles from this location.

There is definitely some risk during transportation of the spent fuel from San Onofre to the proposed site. The Nuclear Regulatory Commission is responsible for ensuring safety through requirements for the canisters and transportation overpacks, which have to be able to maintain canister integrity in a set of design basis accidents.

The canisters weigh more than the capacity of a conventional 4-axle car which is limited to 286,000 lbs. However, by using an 8 axle car, up to 480,000 lbs can be accommodated, which should be sufficient to handle the Holtec canisters and the associated transportation overpack. The size of the load will likely be considered “oversize.” More options will be explained later.



The BNSF line nationwide has 31,000 bridges and 68 tunnels. There are no major bridges and no tunnels at all along the route from San Onofre to Fishel. Smaller bridges and overhead and side clearances will have to be carefully analyzed by the railroad prior to shipment.

My review of the entire route using satellite photos resulted in the impression that the most likely area for needed additional repair and maintenance would be the many small bridges over water culverts.

There are about 30 such culvert bridges in the 21 mile stretch from Cadiz to Fishel alone. Thus, an estimate for upgrades to these lines would probably be up to the 100s of millions and not billions. This is a question that can be put to the railroad lines when they provide their bid on the project.
The BNSF railway now operates the rail line that would be used to transport the spent fuel most of the way to the site. The line to Fishel is shown in a lighter color denoting an “other railroad,” which is the mentioned ARZC line. The target region is circled.
http://www.bnsf.com/customers/pdf/maps/div_ca.pdf

The spur from the BNSF railroad to Fishel is operated by the Arizona and California Railroad, owned by Genesee & Wyoming, Inc. There are no bridges or tunnels along this 21 mile length of the railroad, except for small culverts for rare rain events.

http://www.gwrr.com/operations/railroads/north_america/arizona_california_railroad

Overview from their website:

> The Arizona & California Railroad (ARZC) is a short line railroad that interchanages with BNSF. The ARZC began operations between 1903 and 1907 by the Arizona & California Railway. By 1910, the line had stretched its reach to Cadiz, California.
>
> The ARZC operates 190 miles of main line track. At Cadiz, the ARZC begins with an interchange with the BNSF and continues southeast across the Mojave Desert to Rice, California, then east to cross the Colorado River Arizona/California state line at Parker, Arizona. The railroad continues east to Matthie. The ARZC also has trackage rights into Phoenix on the BNSF Phoenix Branch.

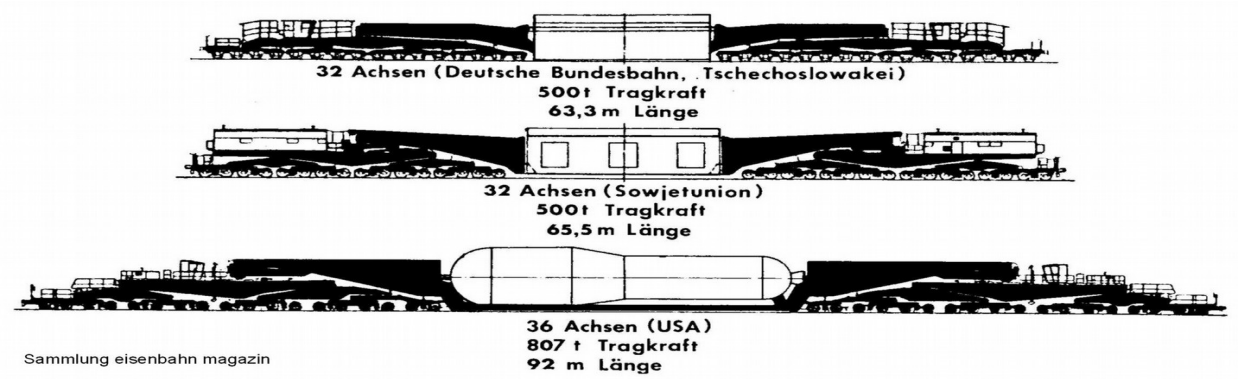
The major commodities moved on the ARZC are include petroleum gasses, steel and lumber, culminating in more than 12,000 cars per year. There are multiple petroleum facilities along the line, and the ARZC provides an important transportation service for customers in moving this product.

The entire length of the ARZC line is shown on the map below.

The BNSF lines are rated at 286,000 lbs, which is the net weight of the load (143 tons). The ARZC line may or may not be rated for that maximum net capacity (they are checking on this question).

The capacity of a heavy-axle railroad car is conventionally 158 tons (gross, including the car, which weighs about 15 tons.) Unfortunately, the design of the canisters + transportation overpacks exceed this weight by about 65 tons. To carry these heavy loads, either an eight-wheel car or a specially designed rail car, called a Schnabel car can be used to distribute the weight among many more wheels and over an area comprising two cars.

In the diagram below, the top two designs use a total of 64 wheels over the two halves and can carry 500 tons. The bottom example uses 72 wheels and can carry 807 tons. By adding more wheels and distributing the load to two cars increases the capacity by more than five times. This type of car may be needed to transport spent fuel in dry canisters and transportation overpacks. The only question then is the condition of the tracks. Spent fuel is transported on a dedicated train at a maximum speed of 15 miles per hour, and there are 151 canisters.



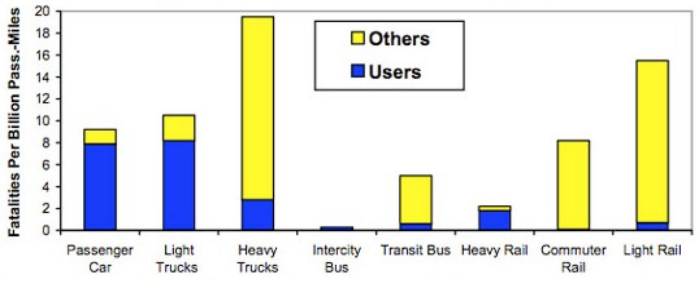
Rail is the safest way to transport Hazardous Materials

Moving and handling spent fuel is where the highest risks of an unintentional accident may occur. Spent fuel canisters must be, by design, also able to be transported, although very few have been movd in the United States. Statistically, rail provides the safest from of transportation.[1]

> Railroads and trucks carry roughly equal hazmat ton-mileage, but trucks have 16 times more hazmat releases than railroads. Statistically, railroads are the safer form of transportation for hazardous materials. ["Hazmat Transportation by Rail: An Unfair Liability", Association of American Railroads, Policy & Economics Dept., January, 2009, pgs. 1-2. In Spraggins, H. Barry, The case for rail transportation of hazardous materials, Journal of Management and Marketing Research]

To be fair, we have to assume that no matter how these are transported, they will be given special attention, including high security, low speeds, and carefully selected routes. However, considering only general operating statistics, heavy rail has much lower accident rates than roads.

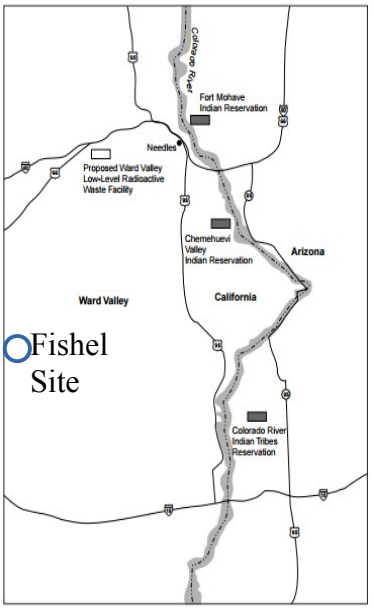
Figure 13 **Transport Fatalities** (FHWA and APTA Data 2002)



Transit travel tends to have lower crash rates than automobile travel, even taking into account risks to other road users.

1 http://steelinterstate.org/topics/rail-vs-truck-and-auto-safety-record

Comparison to Ward Valley



The Fishel area is about 40 miles south of the Ward Valley Low-Level Radioactive Waste Facility site selected attempted to be developed in the mid-1990s.

The Ward Valley project was scuttled because waste was to be directly buried in shallow, unlined trenches and there was a valid concern that the waste could contaminate an aquifer that communicates directly with the Colorado River, 18 miles away, which provides drinking water to some 24 million Southern Californians. Scientists and tribal leaders also cited the devastating impact that the dump—with the potential for radioactive leakage and unavoidable increase in human traffic—would have on the fragile desert, and especially on the desert tortoise[2]. This project was executed without much of any public involvement and released for the first time in the Federal Register announcement that the 1,000 acres of land would be used for this purpose. Lack of early public involvement was a serious mistake.

We can refer to the book "Ward Valley: An Examination of Seven Issues in Earth Sciences and Ecology"[3] which summarizes the seven issues which were important in stopping the project.

> While DOI was considering the land transfer, three geologists from the U.S. Geological Survey (USGS) expressed seven concerns about the site and its evaluation in a memorandum to the Secretary of the Interior, Bruce Babbitt. Although Howard Wilshire, Keith Howard, and David Miller (referred to as the Wilshire group in this report) acted as individuals rather than in official USGS capacities, the DOI asked the National Research Council (NRC) to convene a committee to evaluate their seven technical concerns prior to the DOI decision on the land transfer.
>
> The seven issues, as originally stated in the Wilshire group's memorandum, are:
>
> 1. Potential infiltration of the repository trenches by shallow subsurface water flow.
> 2. Transfer of contaminants through the unsaturated zone and potential for contamination of ground water.
> 3. Potential for hydrologic connection between the site and the Colorado River.
> 4. No plans are revealed for monitoring ground water or the unsaturated zone downgradient from the site.
> 5. Engineered flood control devices like those proposed have failed in past decades at numerous locations across the Mojave Desert.
> 6. Alluvium and colluvium derived from Cretaceous granite appears to make a very high quality tortoise habitat. Sacrifice of such habitat cannot be physically compensated.
> 7. Misconceptions about revegetation enhancement may interfere with successful reestablishment of the native community

2 http://www.sacredland.org/index.html@p=1985.html#sthash.Ia4VNpAh.dpuf

3 http://www.nap.edu/catalog/4939/ward-valley-an-examination-of-seven-issues-in-earth-sciences -- published by the Committee to Review Specific Scientific and Technical Safety Issues Related to the Ward Valley, California, Low-Level Radioactive Waste Site, Board on Radioactive Waste Management, Commission on Geosciences, Environment, and Resources, National Research Council

It is useful to compare and contrast the Ward Valley project with an off-site ISFSI at Fishel, considering the Holtec underground design:

	Ward Valley Low-Level Radioactive Waste Site	Fishel Off-site Independent Spent Fuel Storage Installation (Fishel ISFSI)
Size:	1000 acres with 70 acres developed.	Maybe 50 acre buffer with maybe 3 acres impacted (Need more detailed design to know)
Location:	Only 18 miles from Colorado River.	50 miles from the Colorado River
Hydrology:	First 5 issues of 7 raised raised concerns about how ground water would percolate through unlined trenches of radioactive waste and then flow to the Colorado river. By design, contamination would occur.	The ISFSI is designed to be isolated from ground water. Without an unintended release due to an unlikely accident, there would be no contamination of the ground water. By design, no contamination would occur.
Habitat:	The last two of seven issues are of this type. A very large area of sensitive desert is impacted, is difficult to restore, and would impact the desert tortoise habitat.	Very small area is impacted. Site restoration and desert tortoise concerns are minimal.
Cultural:	Large area disturbed many cultural assets	Small area can be chosen to minimize cultural impacts.
Primary Risk:	The primary risk factor in this project was that the ground water would likely permeate through the radioactive waste and then pollute the Colorado river with radioactivity.	The primary risk factor in this project is that one or more of the canisters might develop a crack and release radioactivity. Worse, a canister could be dropped during handling and break open, and then the contents would need to be sequestered into a spent fuel pool to isolate it and allow it to be repackaged.

Terrorist Risk

All spent fuel sites and ISFSIs will be subject to the risk of intentional releases by hostile actions. However, it seems clear that by moving the fuel to this site, the risk is much lower once we get it there. The San Onofre site is near millions of people while the Fishel site has almost no one within 50 miles. This makes it very unattractive as a terrorist target. Furthermore, the San Onofre site is particularly vulnerable, given that a major freeway is within the exclusion zone and the ocean is nearby, allowing an attack from the ocean without being detected until it is too late. Meanwhile, the Fishel site could be protected with a no-fly zone and fenced off so any attack would be much more difficult to conceal.

We must recognize that during the time the fuel is being transported to the site, the risk would be higher than when it is at San Onofre or the Fishel ISFSI site. Attacks could be launched targeting over 100 reactor sites throughout the U.S. and it is very uncommon, thank goodness. Long term, however, the risk is much lower at this site because it is a very unattractive target given that it is so remote.

We understand that the ISFSI at San Onofre will not be completely underground due to ground water levels. The ISFSI at Fishel could be better designed to thwart terrorist attacks through the use of berms and fenced buffer zones.

Comparison with Status Quo at San Onofre

The current plan is to create a nuclear waste disposal ISFSI at San Onofre for indefinite waste storage. The utility likes to say that they expect the Department of Energy (DOE) to pick up the fuel in 2024 (first transfer in 2030), but honestly, no one really expects this to happen. The earliest we should expect a permanent disposal site is in 2048[4]. We should be somewhat pessimistic that this will happen given that decisions at a federal level are few and far between. The following table compares these options.

	Status Quo at San Onofre	Fishel ISFSI Option
Seismic Risk	Very high. On the moving Pacific Plate	Low. No faults near by. On the North American plate.
Tsunami Risk	Possible.	Zero
Flash Floods	Not a factor.	Needs review. Even if the site is inundated, it may not even need to be pumped out as the heat may evaporate it fairly quickly.
Terrorism	High risk. Near a freeway, near the ocean. Near many people. Hard to secure.	Much lower risk. Easy to secure. No payoff for terrorist attacks. Many other better targets makes this one unlikely.
Population	>8.4 million within 50 miles	almost no one within 50 miles.
Chloride-induced stress corrosion cracking	Very likely. Probably will degrade within decades due to proximity to salty ocean air. Would require replacement of canisters and the use of expensive thicker canisters.	Unlikely as humidity is very low. No salty ocean air for hundreds of miles. No need for very thick canisters, existing canisters would be sufficient for 100+ year period.
Cost	Relatively high because of expected degradation of the canisters due to the environment, resulting in frequent replacement.	Relatively low if we can avoid building the ISFSI at San Onofre to begin with, but transportation costs must be included.
Heat Dissipation	Better due to low ambient temperature	Not as good but surface temp of canisters (400 F) still is higher than ambient even on the hottest days.
Environmental Impact	ISFSI is built at an already contaminated site, so now other site is impacted	Would impact a small other site, of about 10 acres.
Transportation & Handling Risk	Very low transportation and handling risk as canisters are moved only a short distance. However, the handling of the canisters outside the transportation overpacks is about the same.	Higher risk as each canister must be moved a few hundred miles. However, this transportation is entirely by heavy rail using transportation overpacks and thus risk is minimized compared with truck transport.
Slippery Slope - new/extended life to nuclear plants in CA	No direct slippery slope risk. However, not dealing with the waste properly will let everyone forget how difficult it is to deal with the waste properly.	Some risk exists that pro-nuclear advocates will use this installation as a means to excuse additional nuclear plants or extended life to existing plants. However, there are now many reasons to close Diablo Canyon and nuclear plants are generally economically nonviable, and this site could be limited to only closed nuclear plants in California.
Slippery Slope: Fishel becomes a multistate solution	no risk in this option.	If developed, there is always the risk that the off-site ISFSI would grow to accommodate waste from many states. The only defense to this is law limiting it to stranded California waste.
Overall	The primary issues of balance are near-term increased risk during the transportation phase compared with the much lower long-term risk during years of future storage. If the slippery slope issues can be avoided through law, then it seems that the offsite ISFSI deserves serious consideration.	

4 As expressed by the Blue Ribbon Commission on nuclear waste.

Conclusion

Thus, this is one possible area for an off-site ISFSI which would likely provide much better safety for California as a temporary storage site for spent nuclear fuel until a permanent geologic disposal site could be located.

Our proposal is to start a serious project at the state level to look more carefully into this and any other siting option for an off-site ISFSI and halt work on building a permanent (100 yr) structure at San Onofre until the review is done and all options are considered.

We have some serious concerns about the slippery slope issues that have to be limited by law and agreements. Unless these issues can be addressed, such a site will not be embraced by those concerned with new nuclear plants or extending the life of existing plants in California. Also, there is a desire to limit the expansion of this site to accommodate only stranded California spent fuel and not become a general-purpose nuclear waste dumping ground.

[V1.1 addition]
After much discussion of this proposal, it seems that Fishel may be too remote and somewhat difficult to support due to the extremely remote location. A location slightly closer to major roads and existing services will be preferable because the site will need lighting and monitoring, and may even require on-site security personnel. Thus a balanced location will be important rather than extremely remote. There may be some candidates near Cadiz, for example.

[V1.2 Addition]

After a field trip to the Cadiz area, we noted recent (last 10,000 years) evidence of volcanism nearby. The circled area in the adjacent satellite view is the Amboy Crater. From Wikipedia: “This cinder cone is estimated to be 79,000 years old (+/- 5,000 years) and was formed in layers of mostly vesicular pahoehoe – during the Pleistocene geological period. The interior has a lava lake. Lava flows as old as Amboy Crater itself blanket the surrounding area. The most recent eruption was approximately 10,000 years ago.”

We are therefore left with the conclusion that although this was a useful exercise to elucidate the issues surrounding this and other options, it is not a slam-dunk and requires substantial additional review.

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