NUCLEAR WASTE TECHNICAL REVIEW BOARD MEETING

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SUBJECT: **EXTENDED RETRIEVABILITY**

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EXTENDED RETRIEVABILITY
or
Underground Retrievable Storage (URS, Ramspott, 1991)

1. What are the benefits of URS?
2. Background and regulatory aspects.
3. Backfill.
4. High thermal loadings in a URS.

URS COMPARED WITH SURFACE STORAGE

In case of societal breakdown, abandoning surface storage could have serious effects.

Abandonment of a URS would have little consequences. Provides fail-safe storage.

Material in a URS is safe from bombs or missiles and terrorist attacks

ARGUMENTS AGAINST A REPOSITORY

A. If something goes wrong, difficult to remove waste.

Assumes: Final closure with backfilling and sealing.

URS would not require backfill, waste is retrievable.

B. Surface storage will do until better solutions are found.

Assumes: Such solutions will develop.
Society and resources will exist for disposal.

Surface storage may become disposal by default.

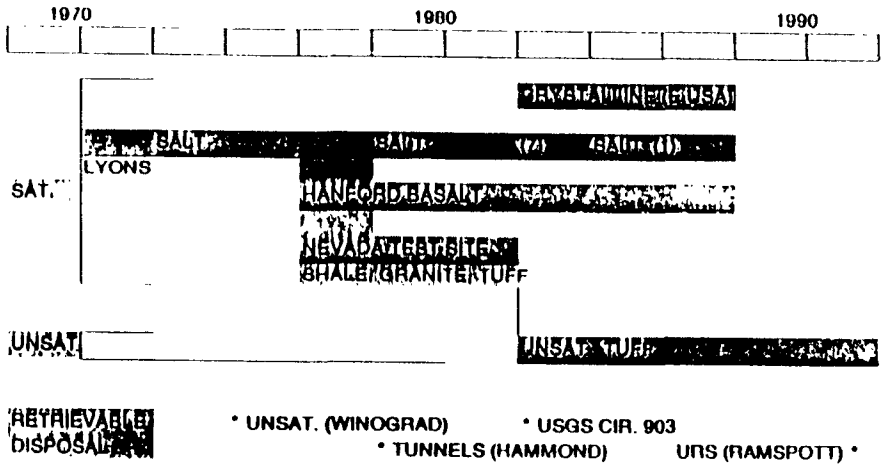
UNDERGROUND RETRIEVABLE STORAGE (URS) COMPARED WITH REPOSITORY

1. Greater confidence from long term monitoring.
2. Can change canisters if better ones develop.
3. Retrieval of the waste if the site proves defective.
4. Option of using future technological solutions.
5. Could use the spent-fuel in future reactors.

"Even while the detailed, long-term behavior of an underground repository is still being studied, it may be marginally safer to go ahead and store reactor waste there (in a way that permits retrieval if necessary) rather than leaving it at reactors"

RETHINKING HIGH-LEVEL NUCLEAR WASTE DISPOSAL, p.5 - Board on Radioactive Waste Management of the National Research Council, 1990

HIGH LEVEL NUCLEAR WASTE DISPOSAL



A URS IS POSSIBLE ONLY IN THE UNSATURATED ZONE

Tunnels will remain dry without pumping.

Backfill to reduce contact with groundwater is not needed.

Sealing of shafts is unnecessary.

Tunnels should remain open indefinitely (unlike salt)

UNSATURATED SITES

Yucca Mountain was the last saturated zone site at NTS.

It was failing as a saturated zone site.

It happened to have potential for an unsaturated site.

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There has never been a screening for unsaturated sites.

USGS with help of 7 states evaluated the Basin and Range for sat. and unsat. areas in 1981 - 1984.

(USGS Prof. Paper 1370, A-H, Circular 904, A-C)

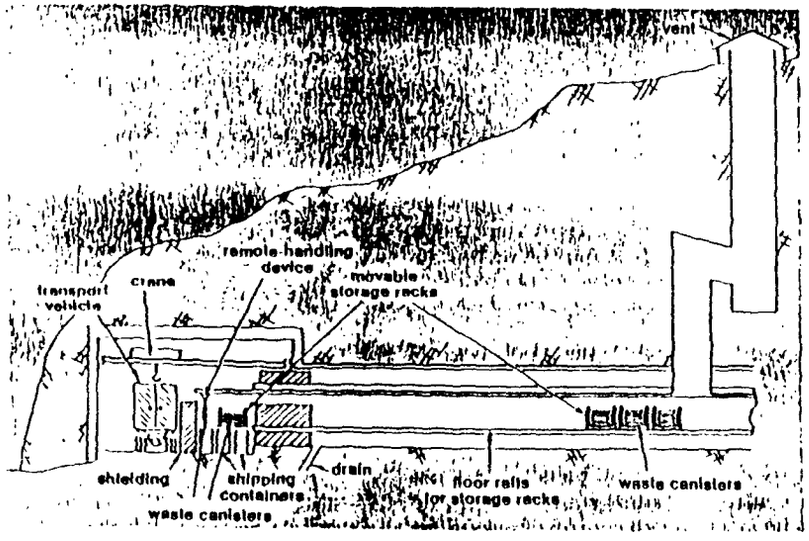
EXTENDED RETRIEVABILITY IN THE UNSATURATED ZONE

Winograd (1974), EOS, 55, 884:
Proposed placing processed waste in 30-40 meter boreholes or trenches. Shallow depth made waste retrievable.

Hammond (1979), Am. Scientist, 67, 146:
Porposed permanently retrievable waste in monitored tunnels with shaft "chimney" and passive ventilation.

Roseboom (1983), U. S. Geol. Surv. Cir. 903,:
Proposed generic unsat. repository similar to Yucca Mtn. with "fully retrievable disposal" and no backfill.

Ramspott (1991), Waste Management 91, 1, 743: Proposed URS with 300 year retrieval, replace canisters if needed.



Hammond (1979), Am. Scientist, 67, 146

CHRONOLOGY OF UNSATURATED ZONE & REGULATIONS

81	**NRC proposed 10CFR60 Tech. Crit.**	(7/8/81)
82	USGS proposed **unsat.** site at Yucca Mtn.	(2/5/82)
	DOE shifts to **unsat.** zone.	(7/82)
	Nuclear Waste Policy Act of 1982 signed.	(1/7/83)
83	**DOE proposed siting guidelines 10 CFR 960.**	(2/7/83)
	NRC released final 10CFR60 for sat. reps. "**unsaturated** zone criteria will be *proposed*".	(6/21/83)
84	USGS Cir. 903, concept of **unsat.** repository.	(9/83)
	NRC proposed further rules for **unsat.** zone.	(2/16/84)
85	NRC publishes final 10CFR60 for **unsat.**	(7/22/85)

EXAMPLES OF SATURATED ZONE THINKING IN 10 CFR 60

FINAL CLOSURE OF REPOSITORY

ASSUMPTION OF BACKFILLING

CONCERNS OVER SEALING SHAFTS AND BOREHOLES

CONTAINMENT PERIOD OF "... THE FIRST SEVERAL HUNDRED YEARS WHEN ... THERMAL LEVELS ARE HIGH "

NRC PHILOSOPHY ON RETRIEVABILITY

"..retrievability does not imply ready or easy access. ... (NRC) recognizes that any retrieval operation would be an unusual event, and may be an involved and expensive operation. The idea is that it should not be made impossible or impractical ...if necessary to protect the public health and safety.

DOE may elect to backfill parts of the repository with the intent that the wastes emplaced there will never again be disturbed: this is acceptable so long as the waste retrieval option is preserved. "

Background to Final Rule, June 21, 1983, Fed. Reg., p.2818.

NRC STAFF ON BACKFILL IN UNSATURATED ZONE

"A geologic repository in the unsaturated zone most likely would be more accessible than (one)... in the saturated zone. ... Further, if DOE selects a backfill plan similar to that discussed by Roseboom (1983), it could be easier to gain access to the waste packages... NUREG-1046, p.19

(Roseboom, USGS Circular 903, p.14: "In the unsaturated zone, tunnels need not be filled with backfill.")

NRC REQUIREMENTS FOR BACKFILL

10 CFR 60.133 (h) *Engineered barriers*: Engineered barriers shall be designed to assist the geologic setting in meeting Long term performance objectives.

Backfill in an Unsaturated Zone Repository

Favorable

Protects canisters from rock falls.

Helps to support tunnels and prevent collapse.

Keeps heat confined to emplacement tunnels.

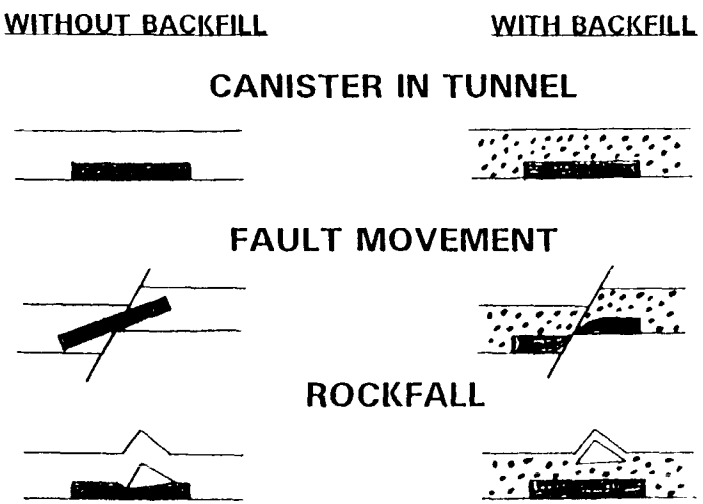
Unfavorable

Ends retrieval of waste.

Ends monitoring of emplaced waste and conditions.

Provides pathways for water to waste (after thermal period).

If new faulting, transmits movement to canisters.



10 CFR 60	EXTENDED DRY	10 CFR 60
Engineered barriers	Thermal barrier	Natural barriers
Canisters + buffer	Energy barrier	Sorptive minerals
Near field	Intermediate field	Far field
> Boiling 1000 yrs	1000s of years	None
Small disturbed zone	Large disturbed zone	Undisturbed

"MODELING OF VENTILATION FOR .... DRIFT RE-ENTRY"
DANKO AND MOUSSET-JONES (1993) IHLRWM CON., 590

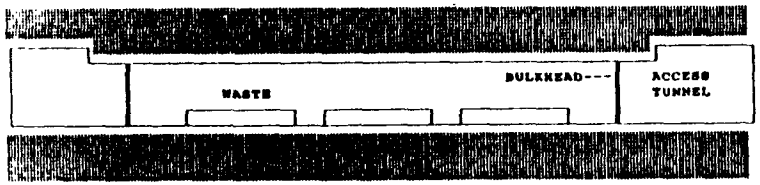
Assumed APD = 114 Kw/Acre

Reopen after 50 years.

Case 1: drift sealed but no backfill.
Case 2: continuous ventilation, 3K to 25K cfm air.

Calculate: time to cool to 125 F.
Less than 3 mo. assuming worst case.
Wet walls reduced to 1 week.
Flow of 15K cfm at 79 F keeps drift accessible.

KEEPING HEAT IN EMPLACEMENT TUNNELS WITHOUT BACKFILL



DESIGNING FOR URS

Transportation System: Short term retrieval vs. long term.

Rail? Leave containers on carriages? How long will rails and ties last under drift temperatures & humidity? Could be difficult to repair/replace.

Rubber tired? Leave containers on carriages? Decay of rubber?

Tunnels: Smaller diameter = more stable opening. Shorter distance for rocks to fall on canisters.

Bulkheads: How long will they last? When they eventually breach, how will it effect later performance?

Shafts: Design to minimize surface water intake?