SALT HANDLING AND DISPOSAL FOR THE NUCLEAR WASTE REPOSITORY PROJECT

A Presentation to the DOE Bimonthly Meeting with the States and NRC

Columbus, Ohio

November 15, 1984

PRESENTATION OUTLINE

By J. Williams/DOE/SRPO

Introduction:

The ESF and repository will mine, store, and dispose of large quantities of salt. SRPO has developed a large body of information on salt management and impacts, and will present this today. Slides of existing facilities and their environs are presented for familiarization.

Salt Volumes:

The ESF and repository are compared with respect to salt mining, storage, and disposal requirements. In comparison to the salt mining and handling which occurs nationally, the ESF and repository volumes are small.

Salt Handling:

Schematic diagrams are shown for familiarization with the planned salt handling processes for the ESF and repository. These schematics show commonly used engineering controls to reduce and/or eliminate salt dispersion.

Salt Dispersion:

Salt handling practices are examined to estimate the rate of salt release into the environment. These estimates are then modeled to produce estimates of salt deposition as a function of distance from the site, and salt concentration in site runoff. Literature provides estimates of salt concentration in the salt pile runoff. Results show that high deposition rates are restricted to the immediate vicinity of the salt pile. Site runoff, on an annual average, is expected to have low salt concentrations. Salt pile runoff, which is contained and controlled, is expected to have high salt concentrations.

Impacts:

Terrestrial impacts, as summarized in NRC data, are predicted to be confined to the immediate vicinity (100-200 meters) of the salt pile. This is also confirmed by field evidence at existing piles. Aquatic impacts are not expected, as site runoff will be controlled and restricted to avoid aquatic impacts. Further, site runoff is predicted to have salt concentrations well below impactive levels.

Disposal Options:

Through a series of studies dating back to 1976, DOE has developed numerous disposal options. Options being considered are identified and discussed. The option of sanitary landfill (for the ESF) is determined to be feasible and is proposed in the draft EA. The option of mine disposal (for the repository) is determined to be feasible and is used in the EA for impact analysis.

Summary:

Three conclusions are available from the presented evidence:

1) At other mines, salt is handled in quantities larger than that being planned at the ESF or repository.

2) Salt impacts, with minimal engineering controls, are limited in extent to the immediate area of the salt pile.

3) Disposal options which are feasible, and which have no expected environmental impact, exist for the ESF and repository.

I. INTRODUCTION

- Story on everything about salt. ESF and Repository produce large volumes of salt which need to be managed, stored, and disposed of in an environmentally safe manner.

- My presentation will briefly cover the following subjects in the order shown:

  (Viewgraph # 1)

- What is salt? Generally, evaporite mineral of which table salt, NaCL, is a major contituent. Salt includes potash, KCl, Trona, $NaCO_3$, and numerous combinations of N_a, K, Mg, and SO_4, CO_3, and Cl.

- Numerous studies in support of our understanding of salt (see chart).

- Pictures of mines (Retsof, PCS, Cane Creek)

PRESENTATION OUTLINE

1. SALT VOLUMES
2. SALT HANDLING ACTIVITIES
3. SALT DISPERSION
4. IMPACTS
5. DISPOSAL OPTIONS
6. GENERAL CONCLUSIONS

RECENT SALT DISPOSAL STUDIES

D'APPOLONIA	1976	IDENTIFIED GENERIC DISPOSAL OPTION
BECHTEL	1982	EVALUATED OPTIONS IN PARADOX BASIN
LANGILL	1983	ASSESSED IMPACT OF DEEP WELL INJECTION
STEARNS-ROGER	1983	DEVELOPED REPOSITORY DESIGN BASES
PARSONS-REDPATH	1984	SUGGESTED BEST DISPOSAL METHODS
NUS	1984	SYSTEMATICALLY COMPARED OPTIONS IN PERMIAN

SALT STORAGE FACILITIES:

- SRPO
- WIPP
- PCS
- PROJECT GNOME
- RETSOF
- TWO EUROPEAN MINES
- CANE CREEK POTASH MINE

IMPACT STUDIES:

- PROJECT GNOME
- ROAD SALT DE-ICING
- COOLING TOWER BRACKISH/SALT WATER DRIFT
- WIPP

TRANSPORT/DISPERSION STUDIES:

- EPA STUDIES ON FUGITIVE DUST
- SALT PILE MEASUREMENTS
- SALT MINE MEASUREMENTS
- RETSOF STUDY

II. SALT VOLUMES

- Let's look at the comparative salt volumes shown in

  Viewgraph # 2
  (Read High Points from Graph)

- Need for disposal exists because salt can't be backfilled to density of original salt. Only 65% can be fitted into the excavation.

- To provide some visual perspective of these differences, the slide (1) shows a 250,000 ton stockpile at a salt producers site in New York. (Note: One ton is approximately 1 cubic yard). This is approximately the amount of salt used annually by the City of Columbus.

- The ESF stockpile is roughly comparable in size whereas the repository stockpile would contain 10-15 times as much tonnage. The PCS stockpile is larger than 10 million tons, and is 3-4 times larger than the repository salt pile.

SALT VOLUMES

ESF - REPOSITORY COMPARISON

	ESF	REPOSITORY
TOTAL TONS EXCAVATED	125-200 THOU.	23 - 27 MILL
TONS IN STOCKPILE	125-200 THOU	3 - 4 MILL
TONS TO BE DISPOSED OF	40-70 THOU.	10 - 12 MILL
TRANSPORT EQUIVALENT	1000-2100 TRUCKS	4000-5000 RAILCARS/YR.
AREA OF PILE	4 - 9 ACRES	50 ACRES
HEIGHT OF PILE	20 - 50 FEET	20 - 50 FEET
COMPARE TO:		
US SALT CONSUMPTION	50 MILL TONS/YR	
US ROAD SALT CONSUMPTION	13 MILL TONS/YR	

ONWI

BATTELLE Project Management Division

III. SALT HANDLING ACTIVITIES

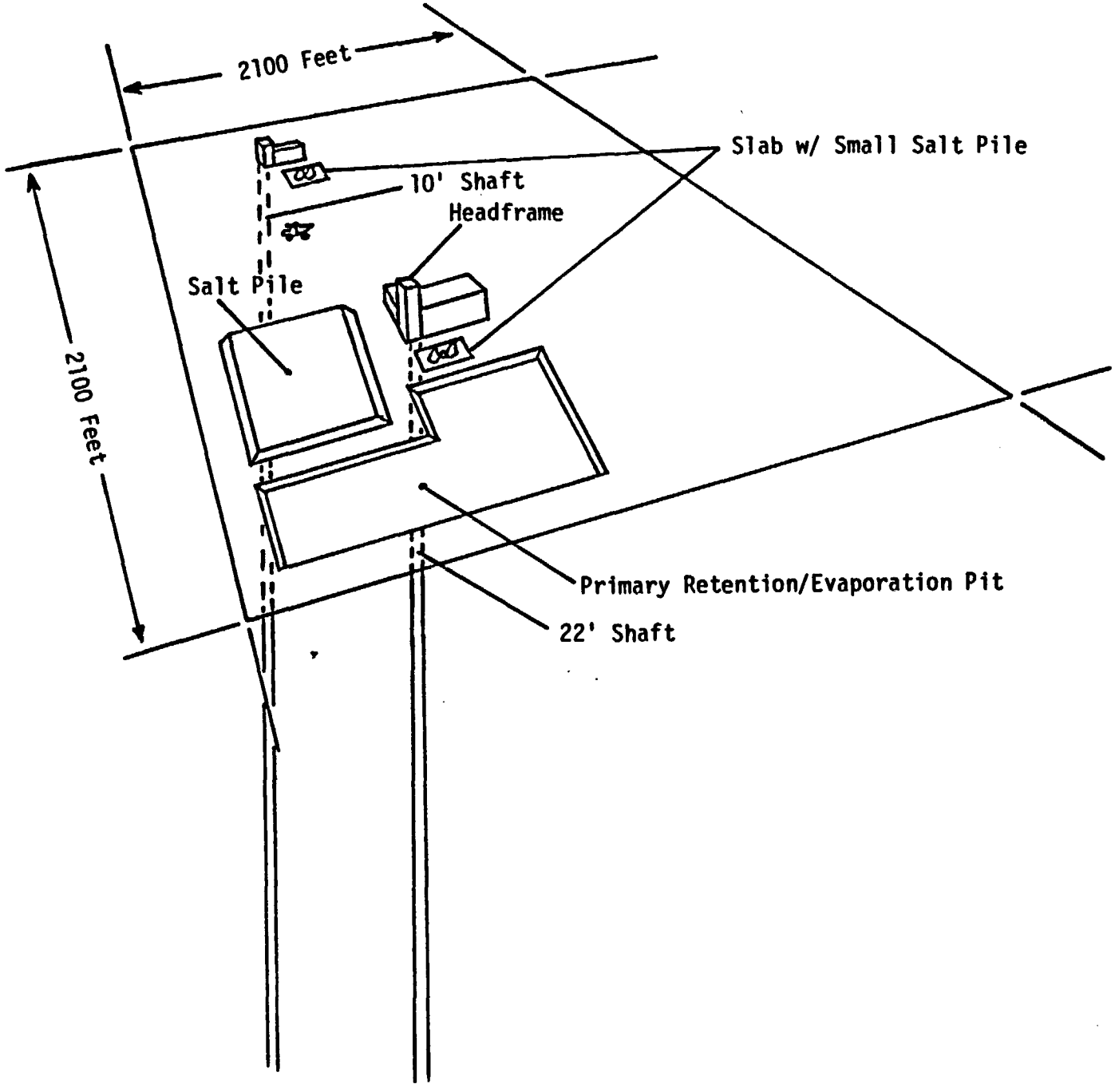
1. ESF

- Underground excavation

  -- Continuous mining machines (see slide)
  -- Skip hoist to surface
  -- Spoils dumped on concrete pad
  -- Transport to storage pile by dump truck
  -- Mining rate, approximately 1000 tons/day

- Storage pile lined and run-off collected

  -- In arid climate, run-off will evaporate
  -- In humid climate, run-off will be disposed of


2100 Feet
2100 Feet
Slab w/ Small Salt Pile
10' Shaft
Headframe
Salt Pile
Primary Retention/Evaporation Pit
22' Shaft

III. SALT HANDLING ACTIVITIES (Cont'd)

REPOSITORY (see slide)

- Mining rate at average rate of 2,500 tons/day (1/2 million tons/year). Peak rate 3 times higher

- Most of the excavated salt will be hoisted to the surface

- At surface, salt is conveyed in enclosed conveyors to live storage and surge building

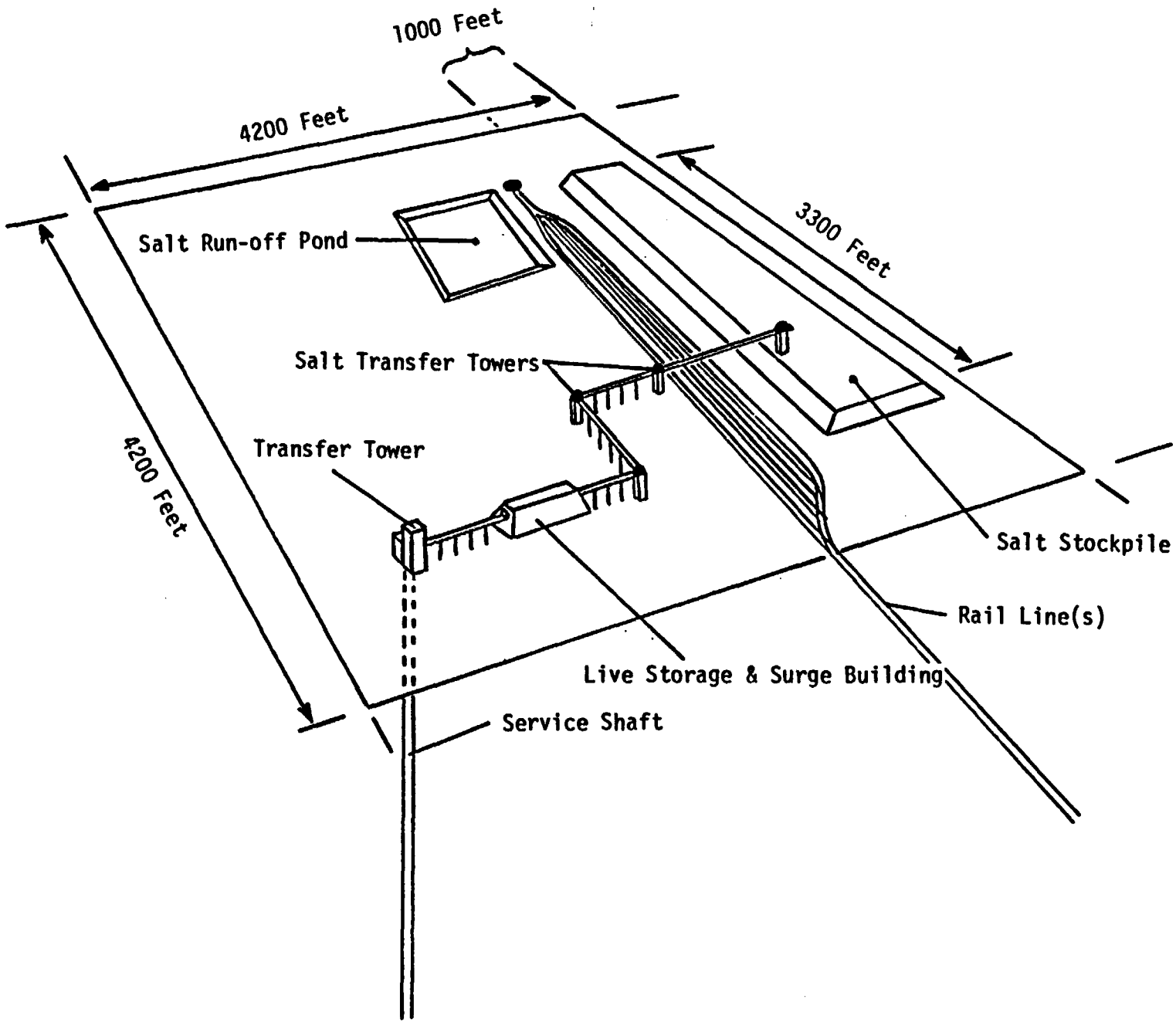
- 10,000 Tons of live storage on the surface (Equivalent to a large train load)

- Salt conveyed in enclosed conveyors from storage to transfer tower

- From tower, salt goes to storage pile or railroad load-out

- Salt runoff goes to a lined salt stockpile runoff pond

  -- Ponds designed to contain 100-year rainfall event


1000 Feet
4200 Feet
3300 Feet
4200 Feet
Salt Run-off Pond
Salt Transfer Towers
Transfer Tower
Salt Stockpile
Rail Line(s)
Live Storage & Surge Building
Service Shaft

IV. SALT DISPERSION

- Public hearings have identified salt dispersion into the environment as a major concern

- In Mississippi, one individual testified several times that salt licks eroded in the rain and generally questioned our plans to store salt on the surface

- We have taken a serious look at the problem. This look has included an examination of salt impacts, of salt management practices in the salt industry and their impacts, and modeling analysis

Salt Dispersion (Cont'd)

Salt can be dispersed into the environment by the actions of air and water

<u>Air Dispersion</u>:

Four sources identified:

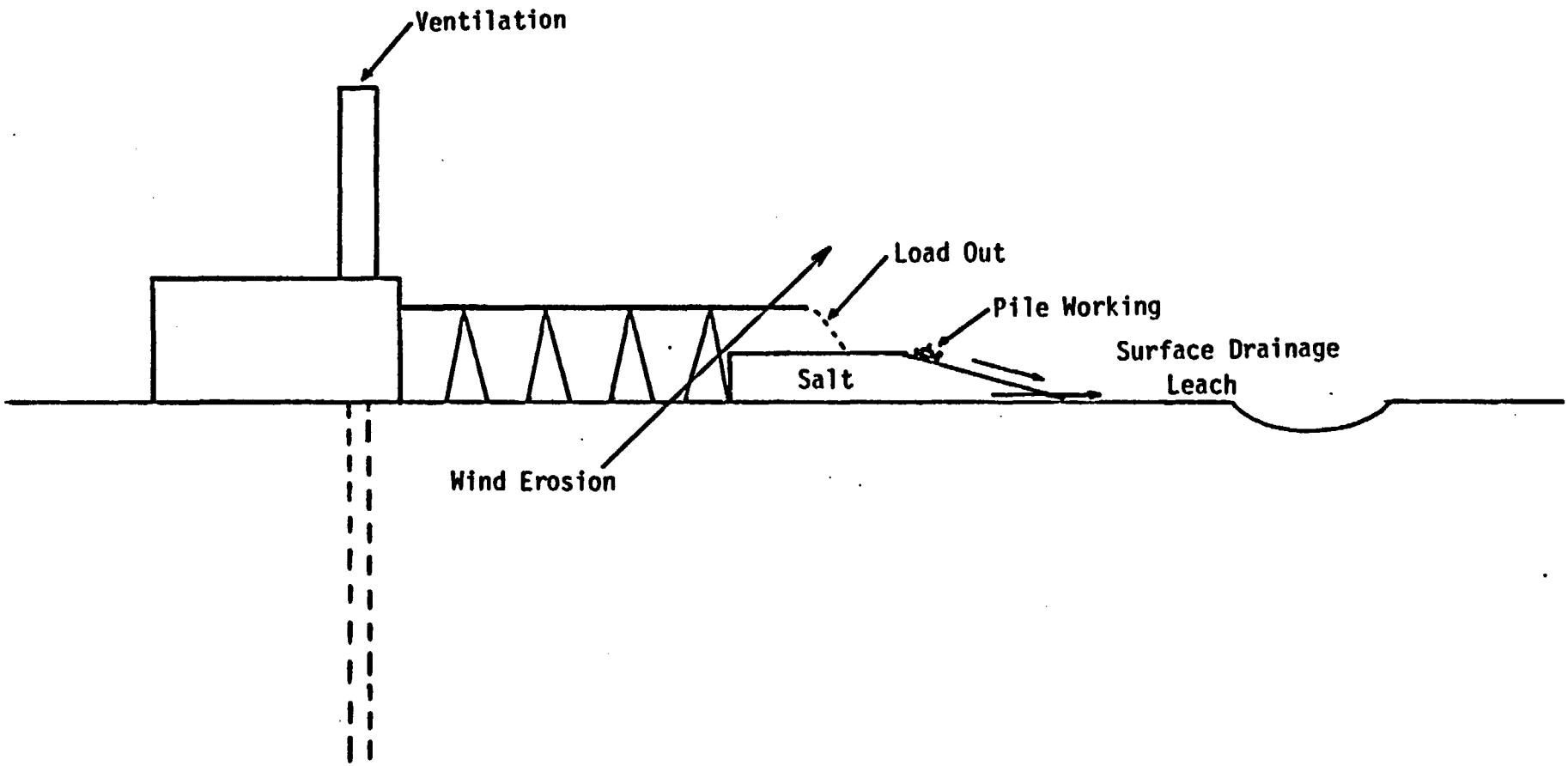
1)	Salt up vent shafts	9
2)	Equipment working the salt	8
3)	Wind erosion of the pile	4.4
4)	Salt loadout on the pile	13

1) Salt up vent shafts

- Near face, underground is very salty
- WIPP found that most salt falls out rapidly, within several hundred feet of face
- Emission estimate (repository) of 9 tons per year found by multiplying potash mine concentration times annual ventilation volume

2) Equipment working salt

- EPA emission factor for fugitive dust from equipment utilization 8 tons/yr - repository


Ventilation
Load Out
Pile Working
Surface Drainage
Leach
Salt
Wind Erosion

Salt Dispersion (Cont'd)

3) Wind erosion of pile

- Nearly all reports show "crusting" when rainfall or when humidity exceeds 70%

- Project Gnome investigated salt around a 17-year old pile. Concluded most salt in soil not due to pile. Absolute upper estimate would be equivalent to 9 tons/year from repository. We use 4.4 tons/year, based upon EPA aggregate pile emission estimates

4) Salt loadout

- EPA emission factor for over burden develops an emission rate 13 ton/year

- Total salt emissions:

Repository	35 tons/year	3-4 years
	14 tons/year	life of facility
ESF	1 ton/year	shaft excavation
+	14 tons/7 months	life of facility

Salt Deposition (Show slide)

Screening analysis, using

- ISC (model)
- Single wind speed (5.5 m/sec)
- Ground level point source
- 35 ton/year emission

- Produced deposition patterns. One is for wind from uniform directions. The other is for wind with a pronounced directionality -- downwind depositions would be increased and up and cross wind depositions would be decreased.

- Pattern shows deposition decreasing rapidly with distance from source

- Used deposition patterns to estimate salt concentrations in general site runoff (We used 800 meter radius, equivalent to 500 acres). Values presented on chart are annual average for increments due to rain water dissolving the deposited salt. There is likely to be significant variation from day to day.

DISTANCE, METERS	DOWNWIND ANNUAL DEPOSITION	AVERAGE ANNUAL DEPOSITION, LBS/ACRE
100	560	190
200	150	50
400	40	13
800	11	4
1200	5	2

GENERAL SITE RUNOFF, ANNUAL AVERAGE INCREMENTAL CONCENTRATION DUE TO RAIN DISSOLVING DEPOSITED SALT		PPM
	ARID	5
	HUMID	1

ONWI

BATTELLE Project Management Division

- Salt (Brine) Runoff from Salt Pile

  This problem is the problem of brine runoff directly from the pile.

  Data from European salt piles shows that rain runoff from sides of pile is 15,000 ppm brine. Rain on flat top of pile tends to seep through pile and leach halite from surface layers. Water becomes saturated (=260,000 ppm) and seeps out at the base, flowing into the runoff pond

- Permian/Paradox: the runoff evaporates

- Gulf ESF:

  Runoff volume of 5,000 bbl/day can be disposed of in injection wells. Current injection wells in Gulf area accept 1-10,000 bbl/day. Specific well owners contacted and willing to accept brine quantities

- Gulf Repository:

  Runoff volume of 25,000 bbl/day. Difficult to dispose of in injection wells. Can cover pile to prevent brine formation. Can evaporate water with currently available technology. (Multiple effect evaporators, now in use in salt mining industry)

IMPACTS - TERRESTRIAL BIOTA

Range of studies to determine impact (chart)

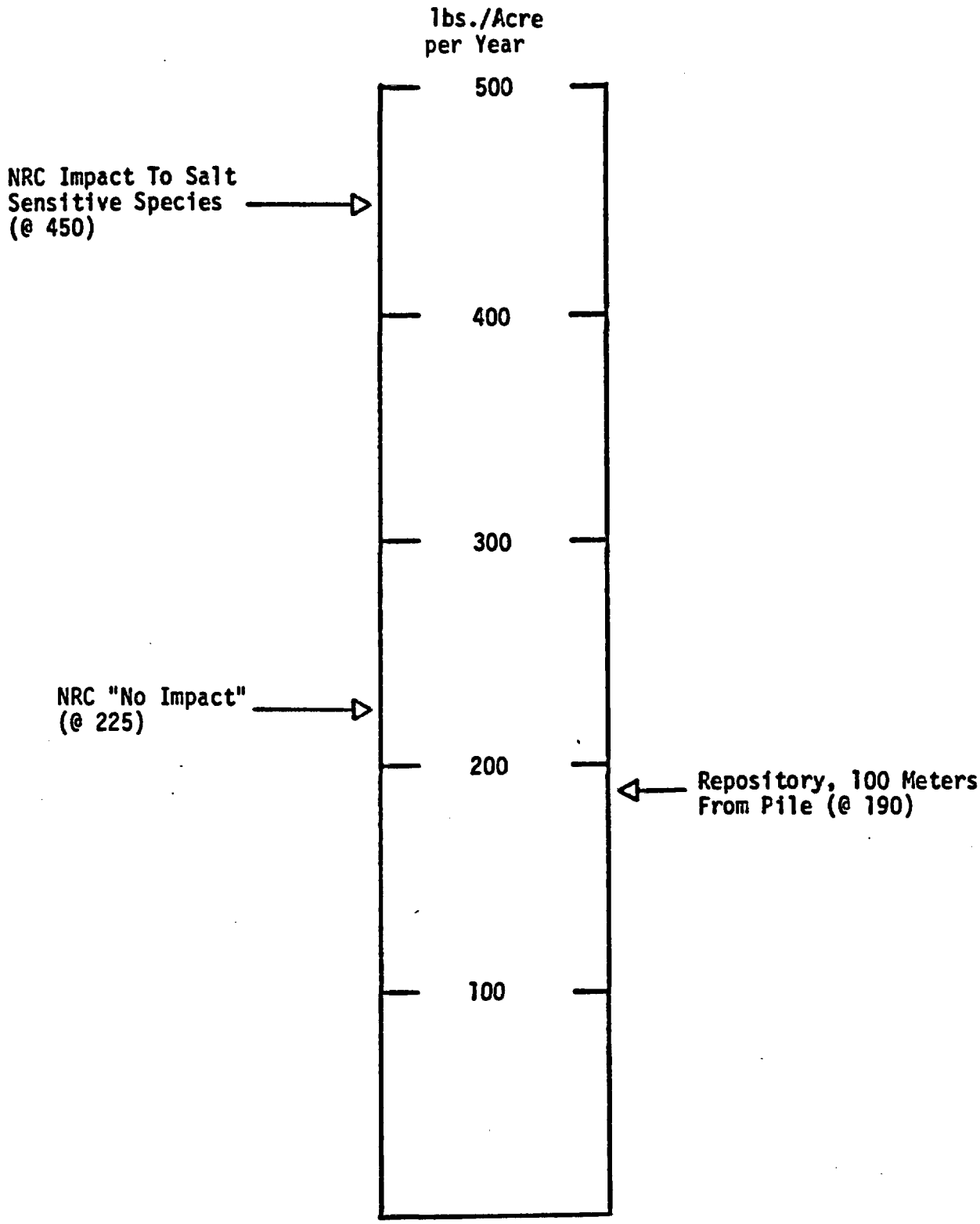
- Most relevant studies are those conducted at or in support of Chalk Point cooling tower. Studies find no impact to terrestrial biota at salt depositions ranging from 0-225 pounds per acre per year.

- The lowest value found in the literature for salt impacts observed bean damage at salt application rates of 360-860 pounds/acre/year.

- Impacts to yields of salt sensitive species are found at application rates of 2000 pounds/arce/year.

- Western ecology tends to have more salt-adapted studies.

- Conclude that impacts from salt pile drift are restricted to immediate vicinity of site. Finding also borne out by observations at existing salt piles.



TERRESTRIAL IMPACTS

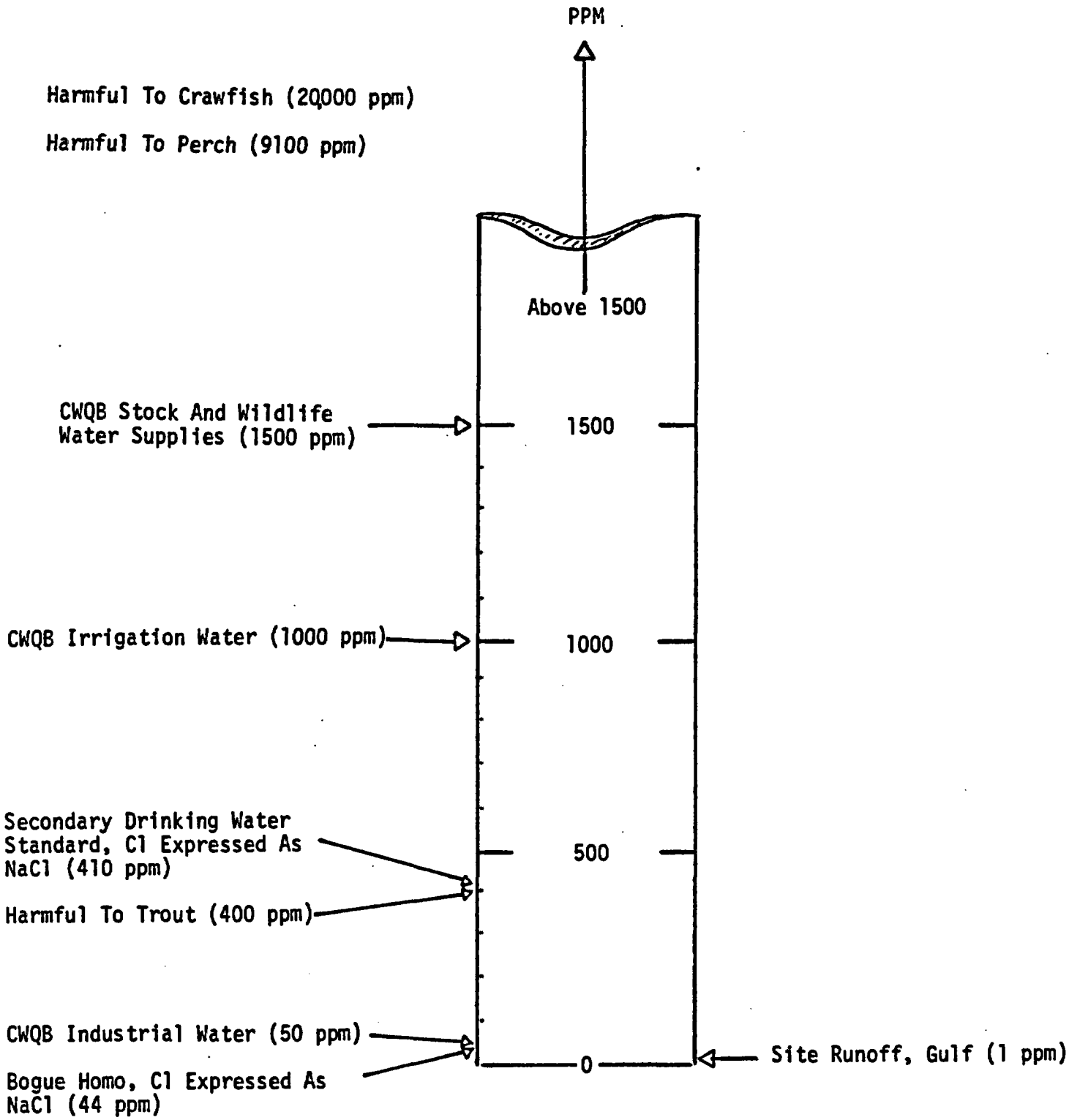
IMPACTS - AQUATIC BIOTA
(Gulf only, Permian, Paradox have no runoff)

Range of studies to determine impact (chart)

- California Water Quality Board - levels for various uses
- Species sensitivity, trout, peach, crawfish
- Bogue Homo (Bow'ga Hoe'ma) river (flows by Richton Dome) chloride concentration expressed as equivalent salt

We expect to have the salt runoff from the site regulated to avoid impacts. The predicted annual average site runoff is well below levels that have environmental impacts.

Conclude salt pile runoff will require covering of pile or treatment (such as forced evaporation) of pile runoff.



AQUATIC IMPACTS

SALT DISPERSION CONTROLS

- Planned Engineering Practices

  -- Lining of ponds and of salt pile and handling area

  -- Diversion of runoff away from salt pile and ponds

  -- Capture and control of rainwater which falls on salt pile area

  -- Enclosure of salt conveyors

  -- Use of skirts and small salt drop distances in loadout facilities

- Available Mitigators

AIR	WATER
Cover pile	Cover pile
Use of water spray to control pile wind erosion	
Use of emission controls on vent stacks	

VI. DISPOSAL OPTIONS

- At least a half dozen studies have addressed the viability of each of these options

(Show viewgraph)

SALT DISPOSAL OPTIONS

- OFF-SITE LANDFILL
- ON-SITE SURFACE STORAGE
- DEEP-WELL BRINE INJECTION
- COMMERCIAL SALE
- OFF-SITE SURFACE DISPOSAL
- OCEAN DISPOSAL
- MINE DISPOSAL

ONWI

BATTELLE Project Management Division

DISPOSAL OPTIONS: SOME COMPARISONS

	HANDLING COST	TRANSPORTATION COSTS	IMPACT
ON SITE DISPOSAL DISPOSAL	$10/TON	0	LONG TERM POSSIBLE LEAKAGE TO SURFACE AND TO GROUND-WATER
OCEAN DISPOSAL	A) $2/TON (GREAT SALT LAKE)	$21/TON (PARADOX)	NONE EXPECTED
	B) MINIMAL, USING EXISTING SPRO DIFFUSERS (GULF OF MEXICO)	$44/TON (PERMIAN)	NEGLIGIBLE, PER SPRO STUDIES
	C) $11.50/TON SOLIDS, BARGING	$5-10/TON (GULF)	UNKNOWN
MINE DISPOSAL	$4/TON (PARADOX)	$24/TON (PARADOX)	NONE EXPECTED
		$16/TON (PERMIAN GULF)	NONE EXPECTED
SALE	-$10/TON	$128/TON (PARADOX) $ 48/TON (GULF) $ 64/TON (PERMIAN) (TO ST. LOUIS. OTHER TERMINI ARE POSSIBLE)	LOSS OF MARKET, JOBS FOR 1% OF SALT INDUSTRY, 3.5% ROAD SALT INDUSTRY

OFF-SITE LANDFILL (ESF)	$10/TON	$24/TON PARADOX	POSSIBLE LONG-TERM CONSEQUENCES FROM LEAKAGE AT LANDFILL.
		$14/TON PERMIAN	
		$4.50-$28/TON GULF	
DEEP WELL BRINE INJECTION	$2/BBLE $36/TON	DEPENDS UPON DISTANCE FROM SITE.	ALTERATION OF GROUND WATER FLOWS. CONSUMPTION OF 22,000 ACRE-FT OF WATER (REPOSITORY) AND 132 ACRE-FT (ESF).
OFF-SITE SURFACE DISPOSAL ON EVAPORITE DEPOSITS	$1-3/TON	DEPENDS UPON DISPOSAL SITE. VERY HIGH FOR GULF. PARADOX, PERMIAN COULD BE LOW.	NONE EXPECTED.

SELECTION OF DISPOSAL METHOD FOR EA

The EA has a planned disposal method for both the ESF and repository.

ESF:

Planned method is disposal in sanitary waste landfill

Contacted sanitary landfills and found regional landfills willing to accept 60,000 tons in late 1980s. Volume is about 30 acre feet. Typical regional landfill has 1,500 acre-feet capacity.

Alternate method being considered is commercial sale. Title to salt would be given to the GSA, who would auction the salt for the best bid. May require subsidy. Informal discussions with salt companies suggest feasibility.

Repository:

Representative method is disposal in evaporite mines. Contacted mine owners and found it to be feasible. Extensive volumes are available. Use of mines would decrease subsidence over mine.

Licensing uncertain (who ever thought about the problem of putting salt into a salt mine), but not expected to be a problem.

Process would have rail-car offloading and transport into the mine enclosed, little local environmental impact.

Alternative methods may be equally acceptable.

OVERALL CONCLUSIONS

I. Both ESF and Repository salt volumes are routinely managed at other salt facilities with various climatic regimes.

II. Observed and predicted salt impacts both show that planned salt handling practices will restrict salt impacts to the immediate area around the pile (several hundred feet).

III. Salt disposal for both the ESF and repository each have several promising options. One option for the ESF and one for the repository have been examined in sufficient detail to demonstrate feasibility.