

May 1991

# **RADIOACTIVE WASTE: SOURCES & CHARACTERISTICS**

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*see  
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**Prepared For:**

**AMERICAN SOCIETY of  
MECHANICAL ENGINEERS**

**1991 RADWASTE SHORT COURSE**

**May 6, 1991**

**Analytical Resources, Inc.  
Engineering Resources, Inc.**



## RADWASTE SOURCES AND CHARACTERISTICS

FROM:

"RADWASTE GENERATION SURVEY UPDATE"  
EPRI NP-5526

PUBLISHED FEBRUARY 1988  
1987-88 VOLUMES UPDATED JANUARY 1989  
1989 VOLUMES UPDATED JANUARY 1990

REPRESENTS MORE THAN 90% OF OPERATING  
UNITS DURING RESPECTIVE PERIODS

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## LOW-LEVEL WASTE STREAMS

- DRY ACTIVE WASTE
- WET PROCESS WASTES
- MISC./ATYPICAL WASTES  
- SG, IN REFUELING POOLS

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## DRY ACTIVE WASTE COMPOSITION

### • COMPACTED WASTE

MATERIALS COMPRESSED FOR VR VIA DRUM OR  
BOX COMPACTION (ON-SITE OR OFF-SITE)

TYPICALLY CONSISTS OF PLASTIC, PAPER, PVC,  
ABSORBENTS, CLOTH, SMALL NON-COMPACTIBLES, ETC.

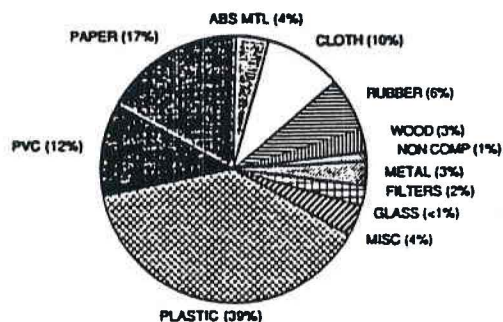
### • NONCOMPACTED WASTE

MATERIAL NOT TYPICALLY COMPACTED PRIOR TO  
DISPOSAL

TYPICALLY CONSISTS OF WOOD, PIPES, VALVES, TOOLS,  
DIRT, CONCRETE, CONDUIT, FILTERS, ETC.

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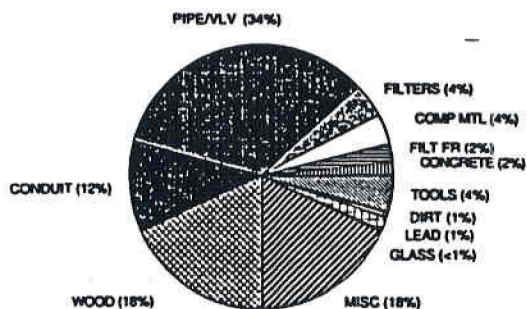
1988-1989  
COMPACTED WASTE COMPOSITION  
PWR: PLANT AVERAGE



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\* SOURCE REDUCTION

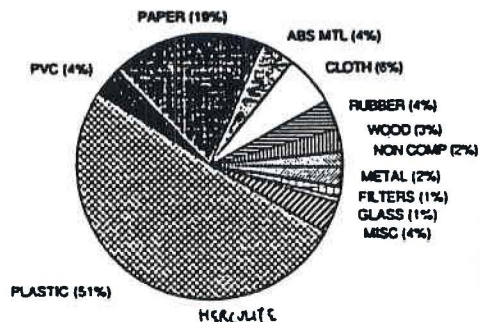
1988-1989  
NONCOMPACTED WASTE COMPOSITION  
PWR: PLANT AVERAGE



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\* CAN BE DECONTAMINATED

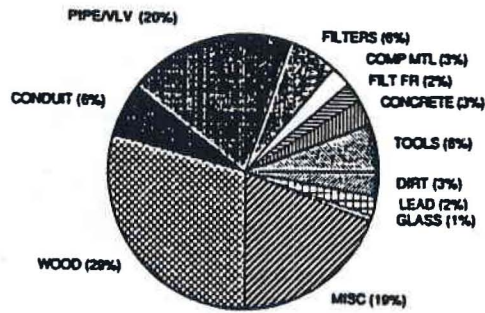
COMPACTED WASTE COMPOSITION  
BWR: PLANT AVERAGE



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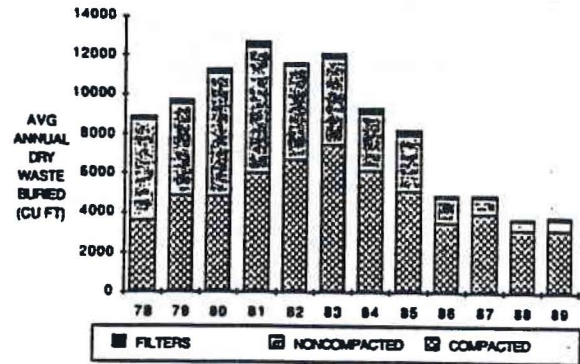
\* SHIPPED, BY VOLUME

NONCOMPACTED WASTE COMPOSITION  
BWR: PLANT AVERAGE



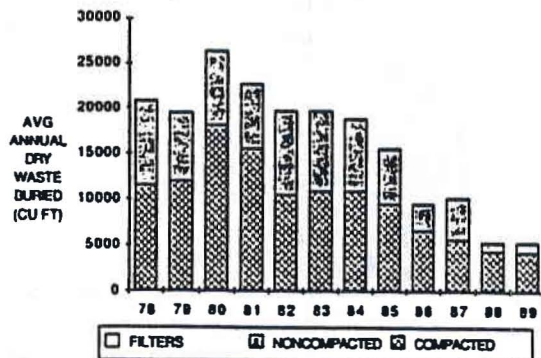
7

PWR AVERAGE ANNUAL DRY WASTE COMPOSITION: ALL PWRs



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BWR AVERAGE ANNUAL DRY WASTE COMPOSITION: ALL BWRs



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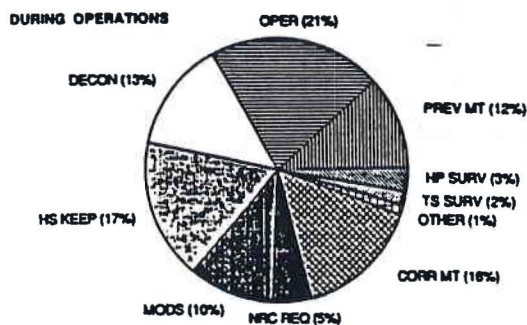
### DRY WASTE SOURCES

- NORMAL OPERATIONS
- OUTAGE CONDITIONS

GENERATION TYPICALLY 3 - 4 TIMES  
GREATER DURING OUTAGE CONDITIONS

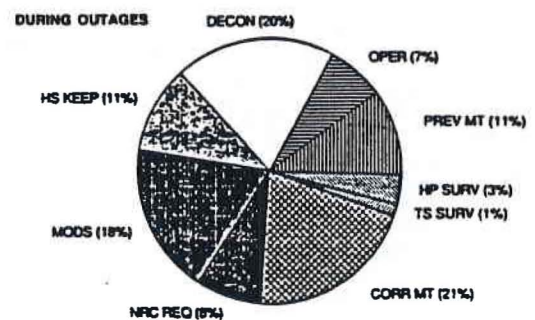
10

COMPACTED WASTE SOURCES  
PWR: PLANT AVERAGE



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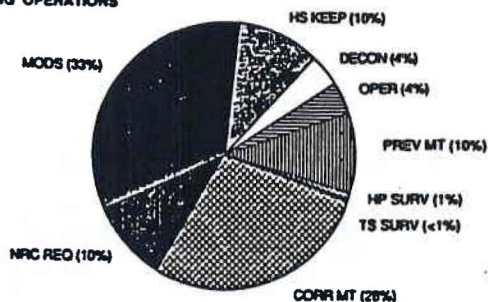
COMPACTED WASTE SOURCES  
PWR: PLANT AVERAGE



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NONCOMPACTED WASTE SOURCES  
PWR: PLANT AVERAGE

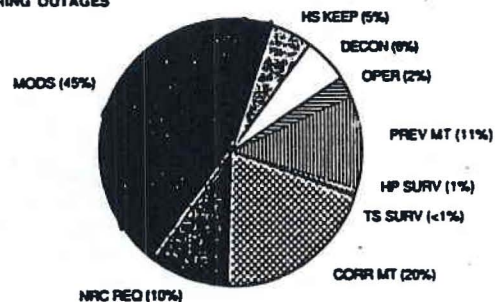
DURING OPERATIONS



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NONCOMPACTED WASTE SOURCES  
PWR: PLANT AVERAGE

DURING OUTAGES



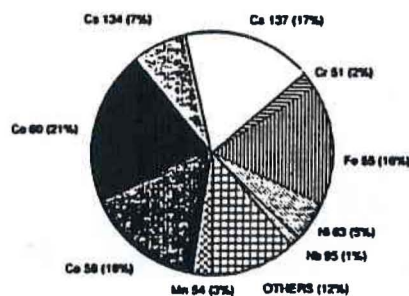
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DRY WASTE CHARACTERISTICS

- COMPACTED DAW
- AVG ISOTOPIC DISTRIBUTION
- AVG SPECIFIC ACTIVITY
- AVG CONTACT RADIATION LEVEL

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COMPACTED DAW ISOTOPIC DISTRIBUTION  
PWR: PLANT AVERAGE



COMPACTED DAW SPECIFIC ACTIVITY  
PWR: PLANT AVERAGE

DRUM: 1.2 millirads/cubic foot  
BOX: 6.8 millirads/cubic foot

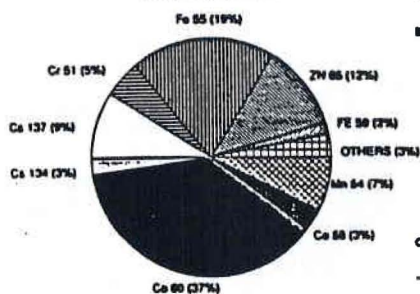
COMPACTED DAW CONTACT RAD LEVEL  
PWR: PLANT AVERAGE

DRUM: 19 millirem/hr  
BOX: 58 millirem/hr

1.2  
6.8

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COMPACTED DAW ISOTOPIC DISTRIBUTION  
BWR: PLANT AVERAGE



COMPACTED DAW SPECIFIC ACTIVITY  
BWR: PLANT AVERAGE

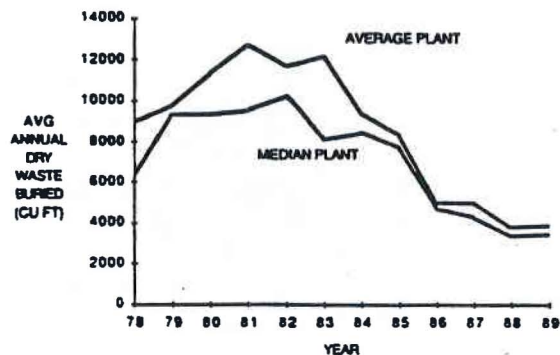
DRUM: 6.7 millirads/cubic foot  
BOX: 6.8 millirads/cubic foot

COMPACTED DAW CONTACT RAD LEVEL  
BWR: PLANT AVERAGE

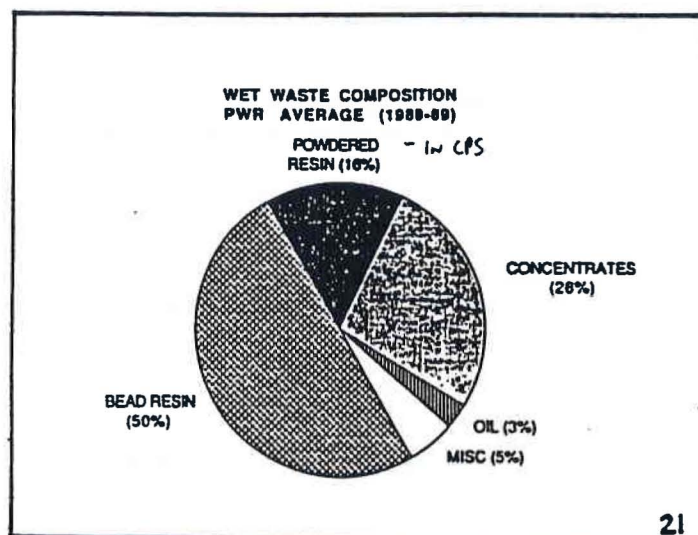
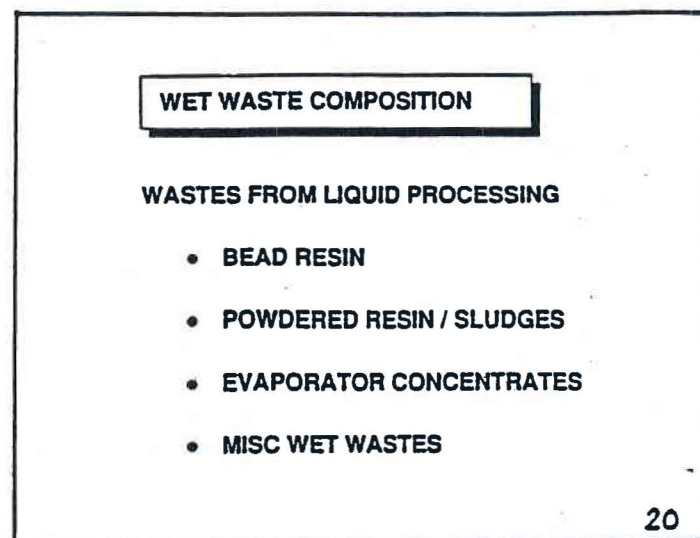
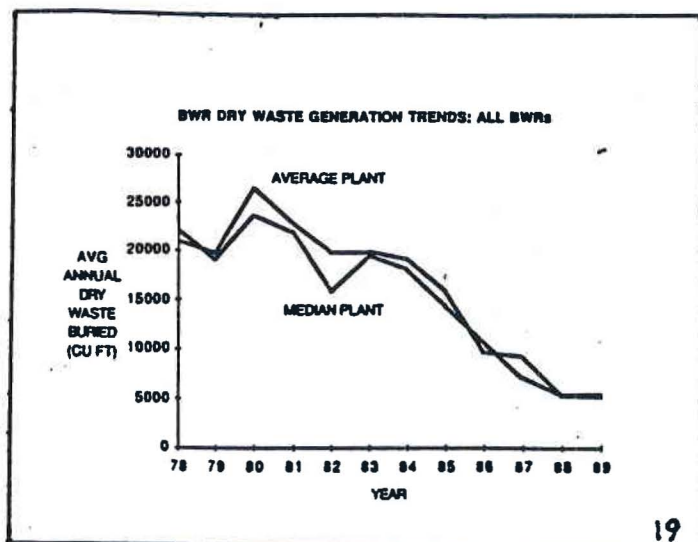
DRUM: 13 millirem/hr  
BOX: 44 millirem/hr

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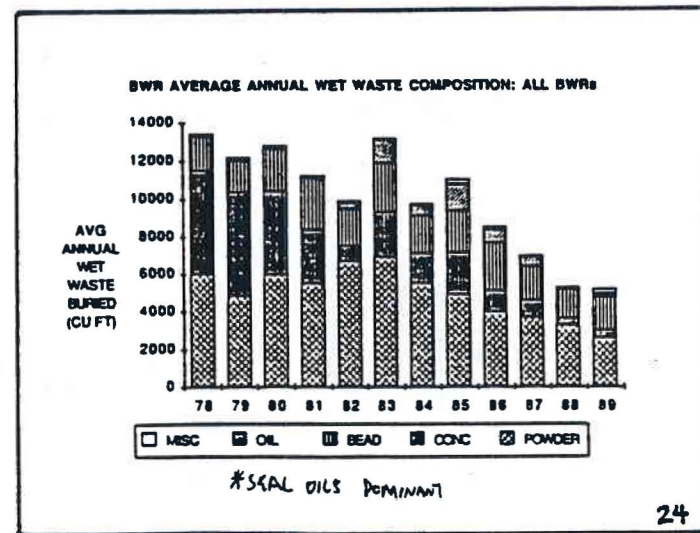
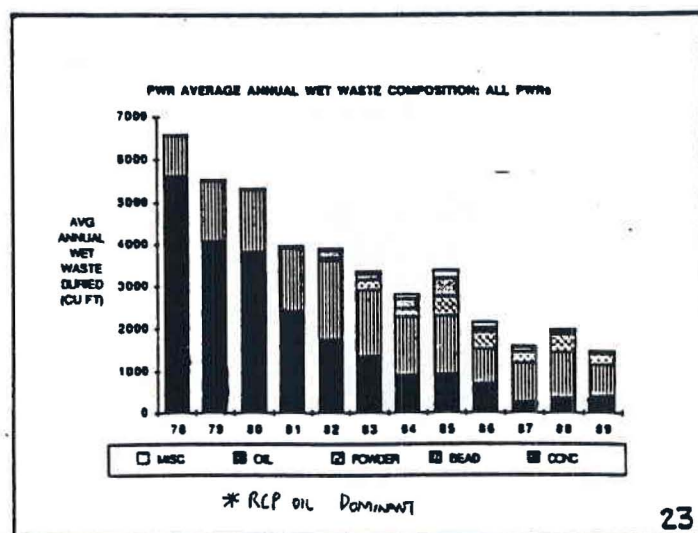
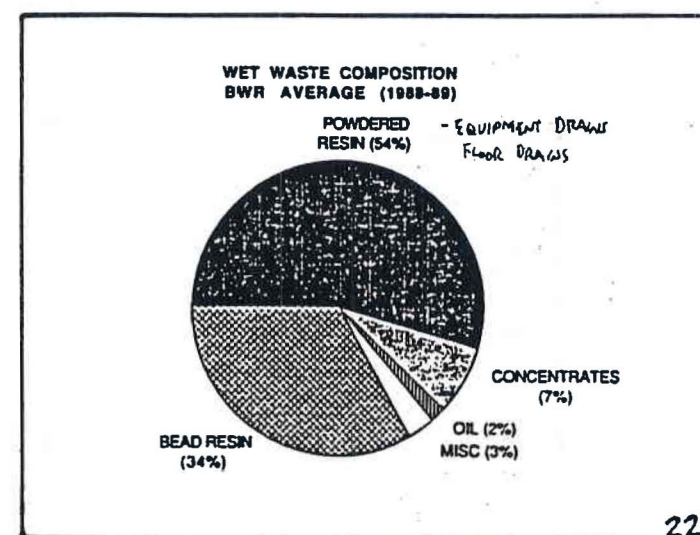
PWR DRY WASTE GENERATION TRENDS: ALL PWRs



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\* CPS : PRIMARY-TO-SECONDARY LEAKS



## WET WASTE SOURCES

### LIQUID PROCESSING SYSTEMS

#### BWRs

- REACTOR WATER CLEAN-UP
- CONDENSATE POLISHING
- SPENT FUEL POOL COOLING
- RADWASTE
  - HIGH PURITY (EQUIP DRAINS)
  - LOW PURITY (FLOOR DRAINS)
  - CHEMICAL (DECON, REGEN SOLN)
  - DETERGENT (LAUNDRY)

#### PWRs

- REACTOR COOLANT *CULS LEAKDOWNS*
- CONDENSATE POLISHING
- SPENT FUEL POOL COOLING
- BORON RECOVERY
- STEAM GENERATOR BLOWDOWN
- RADWASTE
  - MISC WASTE (FLOOR & EQUIP DRAINS)
  - CHEMICAL (DECON SOLN, REGEN SOLN)
  - DETERGENT (LAUNDRY)

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### PWR WET WASTE SOURCES

| PROCESSING SYSTEM        | BEAD RESIN | POWDERED RESIN/SLUDGE           | EVAPORATOR CONCENTRATES |
|--------------------------|------------|---------------------------------|-------------------------|
| REACTOR COOLANT SYSTEM   | 17%        | <i>* HIGH SPECIFIC ACTIVITY</i> |                         |
| CONDENSATE POLISHING     | 20%        | 67%                             |                         |
| SPENT FUEL POOL COOLING  | 4%         |                                 |                         |
| BORON RECOVERY           | 3%         |                                 |                         |
| STEAM GENERATOR BLOWDOWN | 4%         |                                 |                         |
| LIQUID RADWASTE          | 52%        |                                 | 47%                     |
| CHEM WASTES              |            |                                 | 1%                      |
| OTHER                    |            | 13%                             | 52%                     |
| TOTAL %                  | 100%       | 100%                            | 100%                    |

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### BWR WET WASTE SOURCES

| PROCESSING SYSTEM       | BEAD RESIN | POWDERED RESIN/SLUDGE | EVAPORATOR CONCENTRATES |
|-------------------------|------------|-----------------------|-------------------------|
| REACTOR WATER CLEAN-UP  | 6%         | 7%                    |                         |
| CONDENSATE POLISHING    | 39%        | 41%                   |                         |
| SPENT FUEL POOL COOLING | 3%         | 2%                    |                         |
| LIQUID RADWASTE         | 52%        | 50%                   | 83%                     |
| CHEM WASTES             |            |                       | 15%                     |
| OTHER                   |            |                       | 2%                      |
| TOTAL %                 | 100%       | 100%                  | 100%                    |

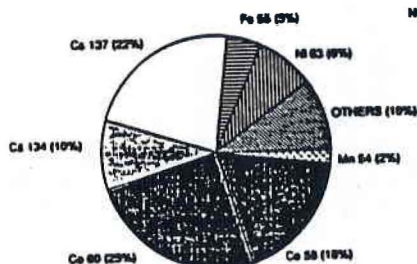
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## WET WASTE CHARACTERISTICS

- BWR - POWDERED RESIN SLUDGE
- PWR - BEAD RESIN
- AVG ISOTOPIC DISTRIBUTION
- AVG SPECIFIC ACTIVITY
- AVG CONTACT RADIATION LEVEL

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### BEAD RESIN ISOTOPIC DISTRIBUTION PWR: PLANT AVERAGE



### BEAD RESIN SPECIFIC ACTIVITY PWR: PLANT AVERAGE

PRIMARY: 1.25 Curies/Cu Ft  
NON-PRIMARY: 0.26 Curies/Cu Ft

### BEAD RESIN CONTACT RAD LEVEL PWR: PLANT AVERAGE

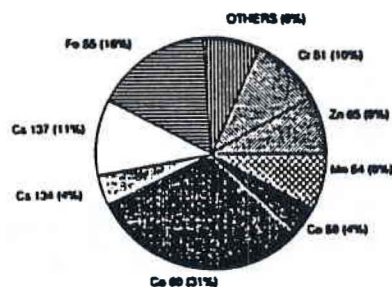
PRIMARY: 54.5 R/hr  
NON-PRIMARY: 2.2 R/hr

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### POWDERED RESIN SLUDGE SPECIFIC ACTIVITY BWR: PLANT AVERAGE

PRIMARY: 1.8 Curies/Cu Ft  
NON-PRIMARY: 0.2 Curies/Cu Ft

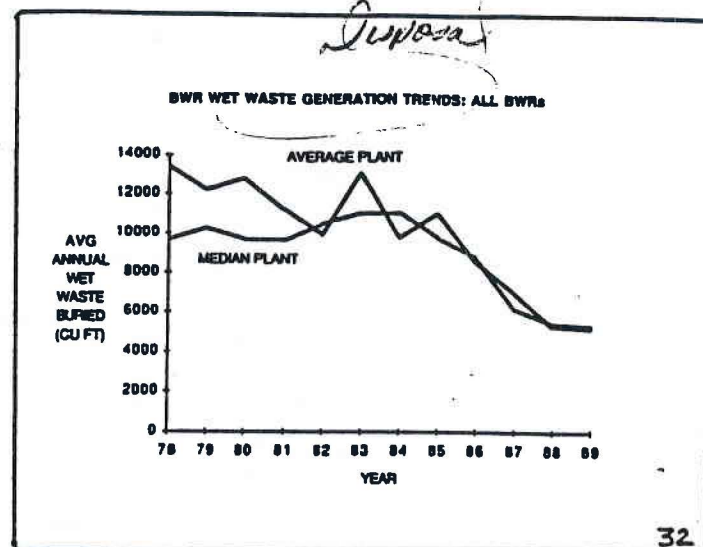
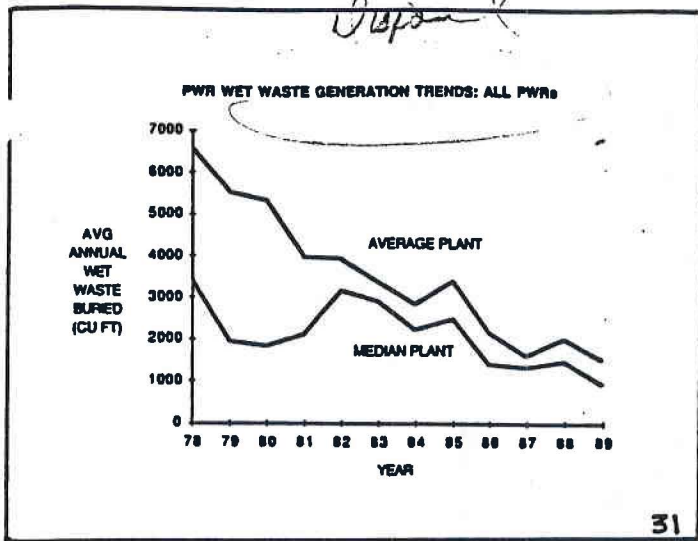
### POWDERED RESIN SLUDGE ISOTOPIC DISTRIBUTION BWR: PLANT AVERAGE



### POWDERED RESIN SLUDGE CONTACT RAD LEVEL BWR: PLANT AVERAGE

PRIMARY: 42.2 R/hr  
NON-PRIMARY: 2 R/hr

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| TYPICAL PLANT WASTE VOLUMES           |  |
|---------------------------------------|--|
| <b>BWR &amp; PWR DISPOSAL VOLUMES</b> |  |
| • ANNUAL AVERAGES                     |  |
| • PER UNIT BASIS                      |  |
| • AVERAGE PLANT                       |  |
| • MEDIAN PLANT                        |  |
| • BY WASTE STREAM                     |  |

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**PWR TYPICAL PLANT WASTE SUMMARY**  
Disposal Volume in Cubic Feet per Unit

| WASTE                      | 1985-86<br>AVERAGE<br>(MP-5526) | 1987<br>AVERAGE | 1988<br>AVERAGE | 1989<br>AVERAGE | 1989-89<br>AVERAGE |
|----------------------------|---------------------------------|-----------------|-----------------|-----------------|--------------------|
| <b>AVERAGE DRY WASTE</b>   |                                 |                 |                 |                 |                    |
| Compacted                  | 4,300                           | 3,950           | 3,150           | 3,150           | 3,100              |
| Noncompacted               | 2,100                           | 950             | 300             | 350             | 500                |
| Filters                    | 200                             | 150             | 100             | 150             | 100                |
| <b>TOTAL DRY WASTE</b>     | <b>6,600</b>                    | <b>4,950</b>    | <b>3,750</b>    | <b>3,850</b>    | <b>3,700</b>       |
| <b>AVERAGE WET WASTE</b>   |                                 |                 |                 |                 |                    |
| Dead Resin                 | 1,100                           | 950             | 1,100           | 750             | 950                |
| Powdered Resin/Sediment    | 400                             | 250             | 400             | 250             | 300                |
| Concentrates               | 800                             | 250             | 350             | 400             | 500                |
| Oils                       | 300                             | 100             | 100             | 50              | 100                |
| Miscellaneous              | 150                             | 50              | 100             | 50              | 100                |
| <b>TOTAL WET WASTE</b>     | <b>2,750</b>                    | <b>1,600</b>    | <b>2,000</b>    | <b>1,500</b>    | <b>1,900</b>       |
| <b>AVERAGE TOTAL WASTE</b> | <b>9,350</b>                    | <b>6,550</b>    | <b>5,750</b>    | <b>5,350</b>    | <b>5,600</b>       |
| <b>MEDIAN DRY WASTE</b>    | <b>6,150</b>                    | <b>4,250</b>    | <b>3,300</b>    | <b>3,450</b>    | <b>3,550</b>       |
| <b>MEDIAN WET WASTE</b>    | <b>1,900</b>                    | <b>1,300</b>    | <b>1,450</b>    | <b>900</b>      | <b>1,100</b>       |
| <b>MEDIAN TOTAL WASTE</b>  | <b>8,050</b>                    | <b>5,550</b>    | <b>4,750</b>    | <b>4,350</b>    | <b>4,650</b>       |

All volumes are rounded to nearest 50 cubic feet.

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**BWR TYPICAL PLANT WASTE SUMMARY**  
Disposal Volume in Cubic Feet per Unit

| WASTE                      | 1985-86<br>AVERAGE<br>(MP-5526) | 1987<br>AVERAGE | 1988<br>AVERAGE | 1989<br>AVERAGE | 1989-89<br>AVERAGE |
|----------------------------|---------------------------------|-----------------|-----------------|-----------------|--------------------|
| <b>AVERAGE DRY WASTE</b>   |                                 |                 |                 |                 |                    |
| Compacted                  | 7,050                           | 5,650           | 4,350           | 4,250           | 4,500              |
| Noncompacted               | 4,900                           | 3,450           | 950             | 1,050           | 1,100              |
| Filters                    | 50                              | 0               | 50              | 150             | 100                |
| <b>TOTAL DRY WASTE</b>     | <b>12,000</b>                   | <b>9,100</b>    | <b>5,350</b>    | <b>5,450</b>    | <b>5,700</b>       |
| <b>AVERAGE WET WASTE</b>   |                                 |                 |                 |                 |                    |
| Dead Resin                 | 2,400                           | 1,800           | 1,500           | 1,750           | 1,800              |
| Powdered Resin/Sediment    | 4,350                           | 3,450           | 3,200           | 2,550           | 2,900              |
| Concentrates               | 1,700                           | 900             | 400             | 400             | 400                |
| Oils                       | 1,100                           | 550             | 50              | 300             | 100                |
| Miscellaneous              | 300                             | 100             | 250             | 150             | 150                |
| <b>TOTAL WET WASTE</b>     | <b>9,750</b>                    | <b>6,950</b>    | <b>5,250</b>    | <b>5,150</b>    | <b>5,350</b>       |
| <b>AVERAGE TOTAL WASTE</b> | <b>21,750</b>                   | <b>16,050</b>   | <b>10,600</b>   | <b>10,600</b>   | <b>11,050</b>      |
| <b>MEDIAN DRY WASTE</b>    | <b>12,400</b>                   | <b>7,000</b>    | <b>5,200</b>    | <b>5,100</b>    | <b>4,750</b>       |
| <b>MEDIAN WET WASTE</b>    | <b>9,250</b>                    | <b>6,150</b>    | <b>5,400</b>    | <b>5,300</b>    | <b>5,300</b>       |
| <b>MEDIAN TOTAL WASTE</b>  | <b>21,650</b>                   | <b>13,150</b>   | <b>10,600</b>   | <b>10,400</b>   | <b>10,050</b>      |

All volumes are rounded to nearest 50 cubic feet.

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| INDUSTRY RADWASTE TRENDS              |  |
|---------------------------------------|--|
| <b>BWR &amp; PWR DISPOSAL VOLUMES</b> |  |
| • 1978 THROUGH 1989                   |  |
| • AVG CU FT PER UNIT-YEAR             |  |
| • TOTAL WASTE - AVG / MEDIAN PLANT    |  |

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*This is disposal trend not as "generated"*

