

**Overview of Report “Seismic Issues for
Consideration in Site Selection and Design of a
Potential On-Site CERCLA Waste Disposal Facility
at the Paducah Gaseous Diffusion Plant”**

Background

- DOE is evaluating waste disposal alternatives at PGDP
 - remediation wastes
 - D&D wastes
- One option DOE is considering is an on-site CERCLA waste disposal facility
- Seismic activity presents a key siting/design consideration

Objectives of Technical Memo

- First step is addressing seismic issues relating to:
 - site selection
 - design
- Determine if seismic concerns represent an insurmountable barrier; if not:
 - develop preliminary siting criteria
 - develop preliminary design criteria

Scope

- Review published documentation
 - geologic setting
 - seismologic setting
 - identify features or unstable ground
- Review regulations that identify seismic siting and design requirements
 - Kentucky
 - EPA
 - DOE Orders
 - NRC
- Review seismic design basis
 - PGDP facilities
 - other DOE CERCLA waste disposal facilities
 - performance of landfills subjected to large earthquakes

Key Terms

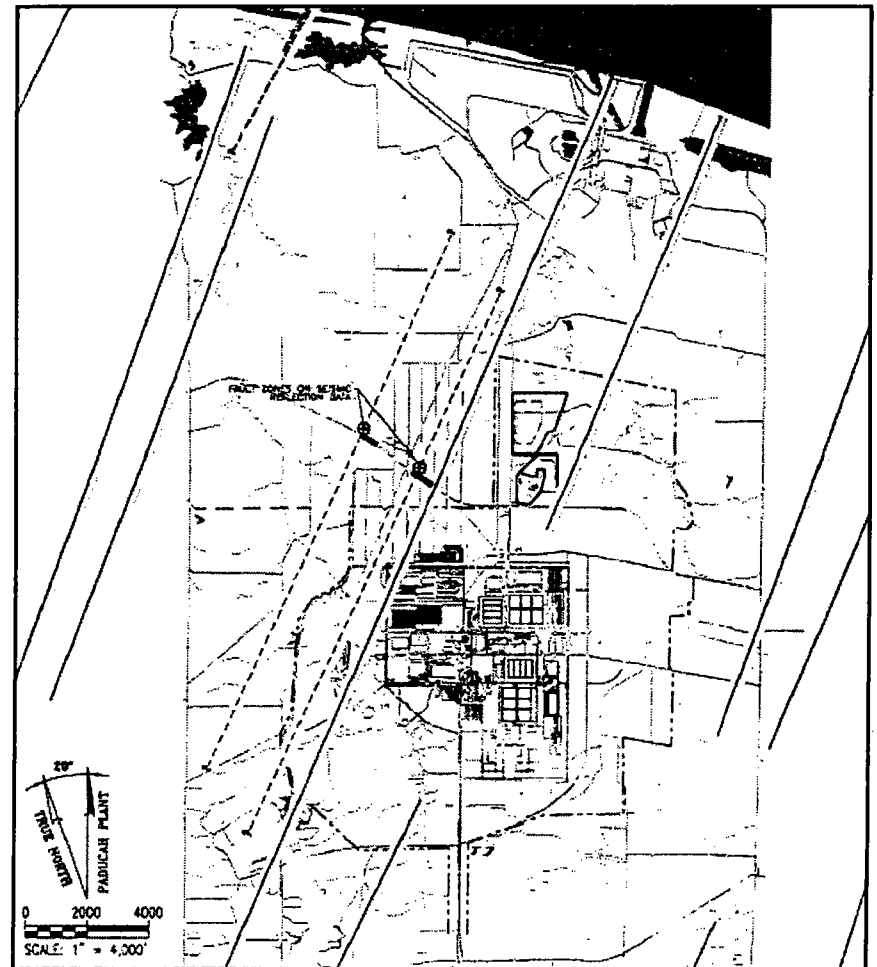
- Holocene
 - Geologic term referring to the past 10,000 to 12,000 years. Regulations focus on faulting that has occurred during this time frame.
- Pleistocene
 - Geologic term referring to the period older than Holocene but less than approximately 2 million years in age.
- Liquefaction
 - Temporary transformation of soils from a stable to unstable condition due to a rise in water pressures caused by shaking.
- Acceleration (g)
 - A measure of the strength of shaking caused by an earthquake. Usually expressed as a fraction or percent of gravity (g). It includes both horizontal and vertical components.

Geologic/Seismic Setting

- New Madrid Seismic Zone located southwest of the PGDP
 - location of large historical earthquakes
 - location of large Holocene earthquakes (less than 10,000 years ago)
- Wabash Valley Source located northwest of the PGDP
 - location of moderate historical earthquakes
 - location of large Holocene earthquakes (less than 10,000 years ago)
- Paducah Area
 - no large historical earthquakes
 - no evidence of large Holocene earthquakes
- Faults are in exposed Pleistocene sediments (>10,000 and <2 million years old)
 - 4 miles east of PGDP
 - 5 miles northwest of PGDP

Geologic/Seismic Setting (con't)

- Kentucky Geological Survey remote sensing studies
 - identify lineaments in vicinity
 - suggest faulting in Pleistocene (>10,000 and <2 million years old) sediments at PGDP
 - no clear evidence of Holocene faulting (last 10,000 years)



Geologic/Seismic Setting (con't)

- PGDP is located on generally flat “upland” surface
 - saturated granular soils are older and denser
 - less prone to liquefaction
 - less prone to slope failure
- Past PGDP modeling studies performed by the US Army Corps of Engineers in 1993:
 - considered 7.3 magnitude earthquake with epicenter 50 km away
 - found foundation soils generally stable
 - identified isolated pockets of sands and gravels that could settle less than one inch

Regulatory Considerations

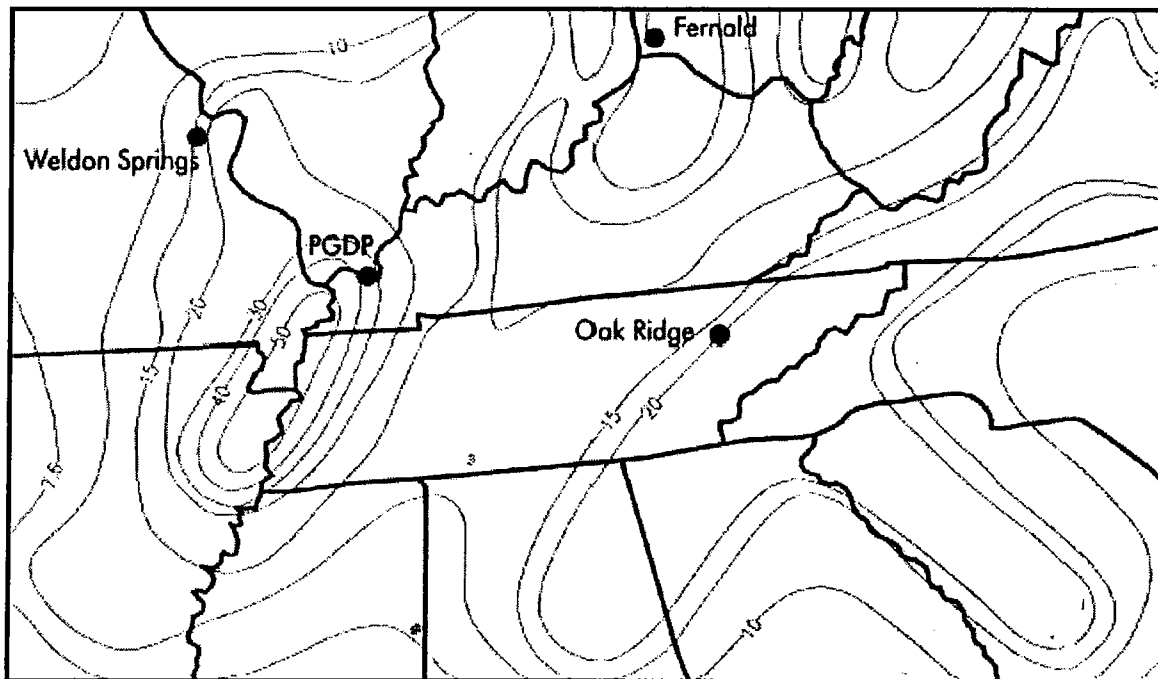
- Commonwealth and Federal Regulations
 - RCRA Subtitle C (hazardous wastes)
 - RCRA Subtitle D (municipal wastes)
 - TSCA (Toxic Substances Control Act)
 - LLRW (low-level radioactive wastes)
 - mixed wastes
- DOE Orders and Standards
- Significant degree of overlap
 - Commonwealth generally reflects federal regulations
 - generally well-defined set of regulations

Proposed Site Selection Criteria

- Areas will be avoided that are within 200 ft of a fault that has had displacement in Holocene time (within the last 10,000 to 12,000 years)
 - studies are required for sites within 3,000 ft of Holocene Fault or within 3,000 ft of lineation that suggests the presence of a Holocene Fault
- Areas will be avoided that are susceptible to slope failure, excessive settlement, or liquefaction
- These criteria mitigate the potential for
 - fault movement causing displacement of facility structures
 - fault movement resulting in vibratory ground motion that can cause damage
 - ground shaking that can cause ground failures such as slope failure, settlement, and liquefaction

Proposed Seismic Design Criteria

- The facility will be designed to withstand ground shaking caused by infrequent large earthquakes. Regulations require that the structure be designed to:
 - resist levels of ground shaking of an earthquake with no more than 10 percent probability of occurring during the next 250 years (0.40 g)
 - this coincides with an earthquake with a return period of approximately 2,500 years



Proposed Seismic Design Criteria (con't)

- The facility shall address seismic hazards consistent with DOE orders and standards
 - basis for the design of structures or features at DOE facilities
 - provides constraints on vertical ground motions
- All containment systems will be designed to withstand predicted ground displacement resulting from seismically induced liquefaction, slope failure, or settlement

Past Seismic Investigations at PGDP

- In 1960s and 1970s, designs were based on an earthquake with a 250-year return period (0.18 g)
- Recent PGDP building upgrades are based on performance category and return periods of 500 years, 1,000 years, and 2,000 years
- C-746-U Landfill is designed to meet 0.4 g
- Recent (1999) site-specific probabilistic seismic hazard analysis conducted by Risk Engineering Inc.
 - New Madrid Seismic Zone
 - Wabash Valley
 - Local Site Conditions

The 1999 Risk Engineering site-specific study found that the ground motion resulting from the 2,500-year earthquake event is approximately 0.4 g.

Conclusions

- PGDP is located in a Seismic Impact Zone and seismicity is a key siting/design consideration
- Based on information reviewed to date, seismicity does not present an insurmountable barrier to the construction of a potential on-site CERCLA waste disposal facility cell
- Established design and construction methods can adequately mitigate the seismic hazard (e.g., flatten side slopes, design for limited settlement)
- A potential on-site CERCLA cell would be evaluated as part of a feasibility study.