Burnup Credit
Design Certification Issues

Bill Lake

Transportation Branch
Transportation and Logistics Division
Civilian Radioactive Waste Management System
Management and Operating Contractor

Nuclear Waste Technical Review Board
Denver, Colorado
July 13, 1994

Introduction

- **Burnup Credit**
- **Assurance of Subcriticality**
- **Current OCRWM Strategy**
- **Key Issues**
- **Summary**

Burnup Credit

- **Definition: Burnup credit recognizes and uses the decreased reactivity of spent fuel in demonstrating subcriticality**
- **Burnup credit is a factor in increasing capacities of casks and MPCs**
- **NRC rules allow the use of burnup credit**
- **Burnup credit can be used without reducing safety**

Assurance of Subcriticality

- K_{eff}, the measurement of criticality
- Design of criticality safety systems
- Regulatory requirements/practice
- The water flooding assumption for LWR fuel
- Fuel baskets and flux traps

Current OCRWM Strategy

- Early decision on burnup credit needed to support MPC
- Development of topical reports
- Technical exchanges with NRC

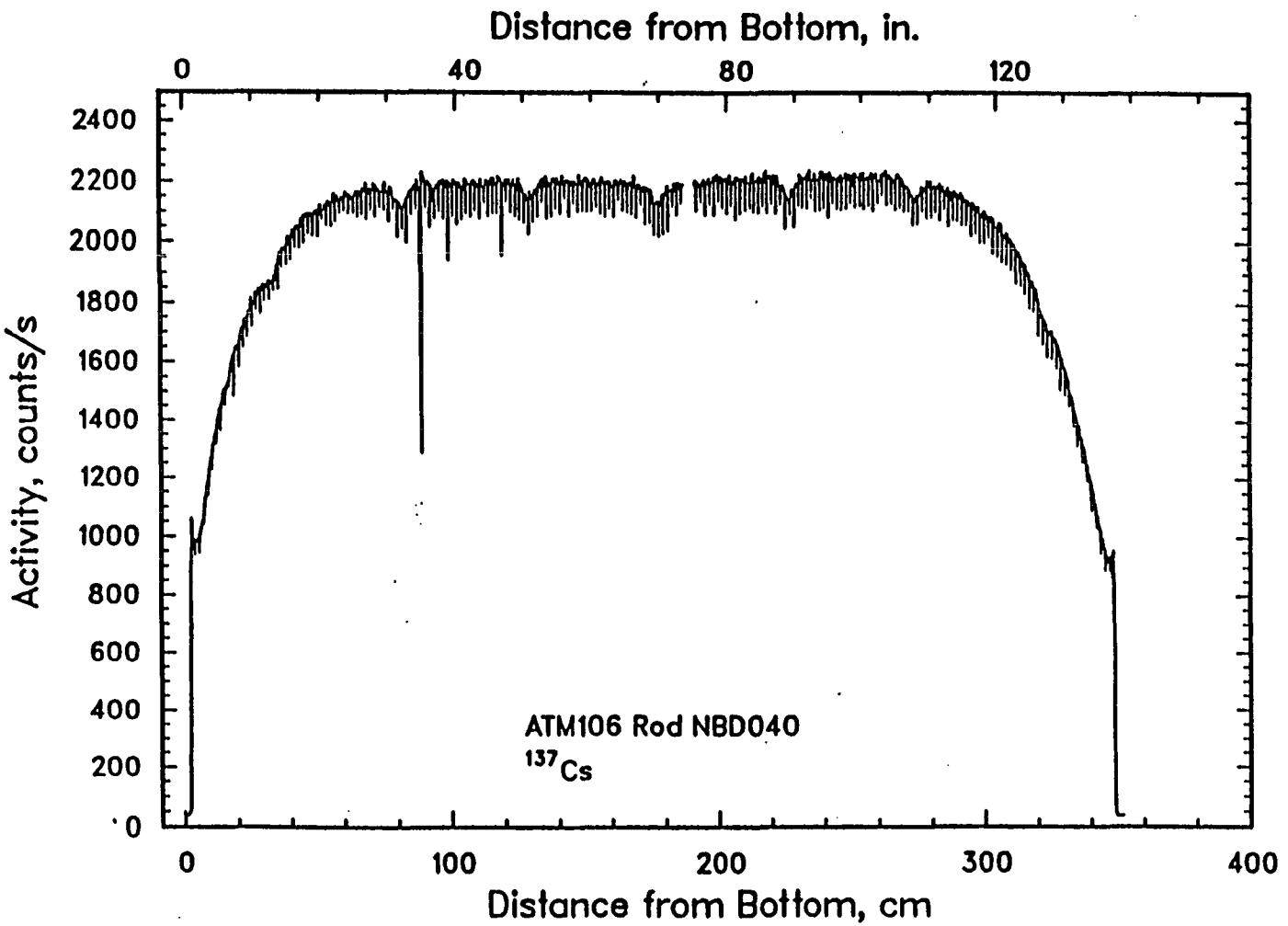
Key Issues

- Axial burnup profiles
- Benchmarking actinide & fission product inventories
- Benchmarking criticality analysis methods
- Burnup verification

Axial Burnup Profiles

- Axial distribution of burnup in spent fuel is not uniform
- Currently, PWR spent fuel is being investigated for burnup credit
- PWR fuel is characterized by uniform central region and underburned ends
- PWR end effects have been characterized and are readily accounted for in criticality safety design

Axial Burnup Profile



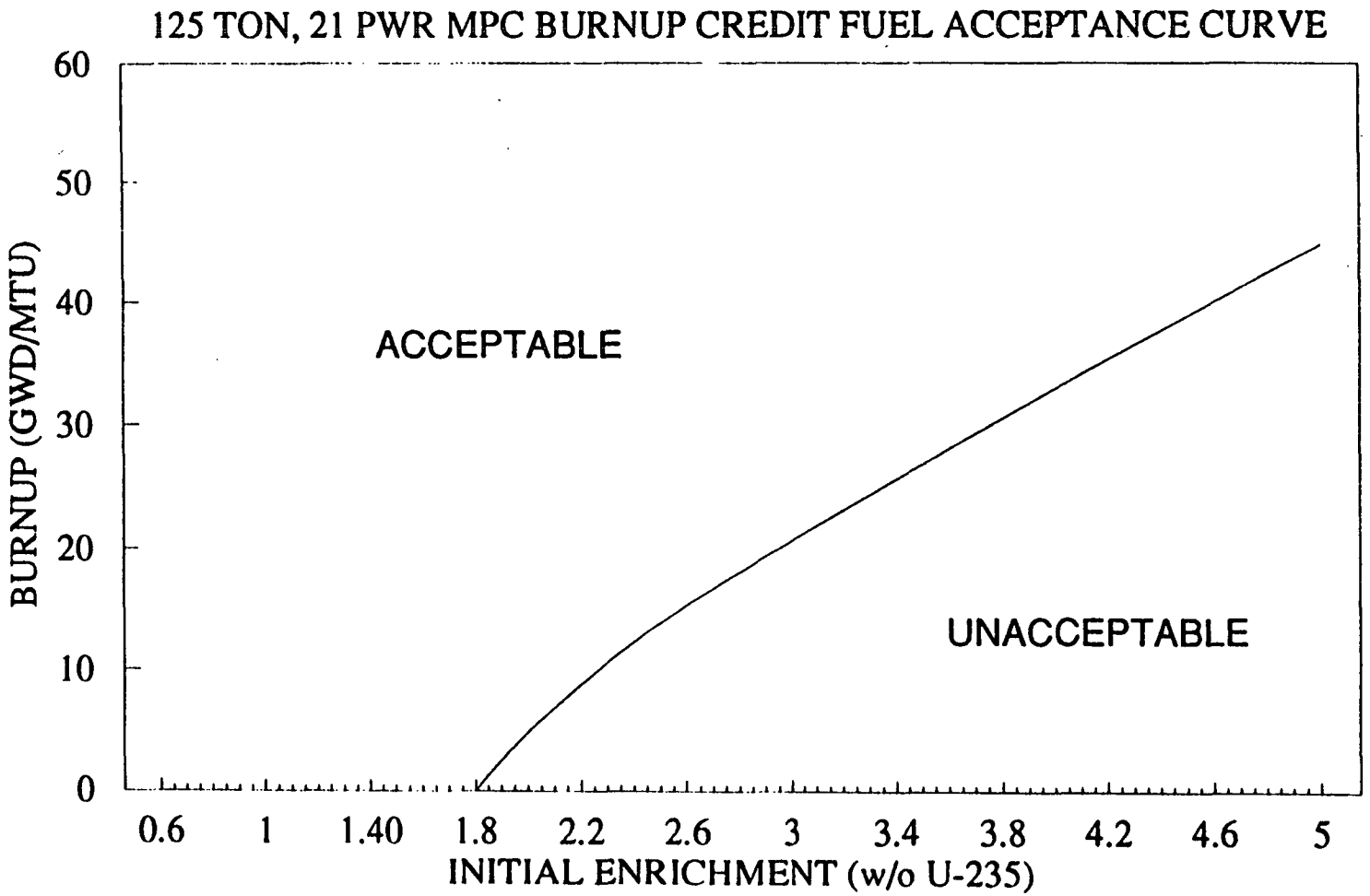
Benchmarking Actinide & Fission Product Inventories

- Radiochemical assays have been performed on spent fuel samples
- Assays benchmark radionuclide prediction codes
  - Selected actinides & fission product neutron absorbers have been assayed
  - All fissile nuclides have been assayed

Benchmarking Criticality Analysis Methods

- Fresh fuel critical experiments
- Mixed-oxide critical experiments
- Gadolinium Experiment
- Reactor restart critical data used to characterize and benchmark spent fuel attributes

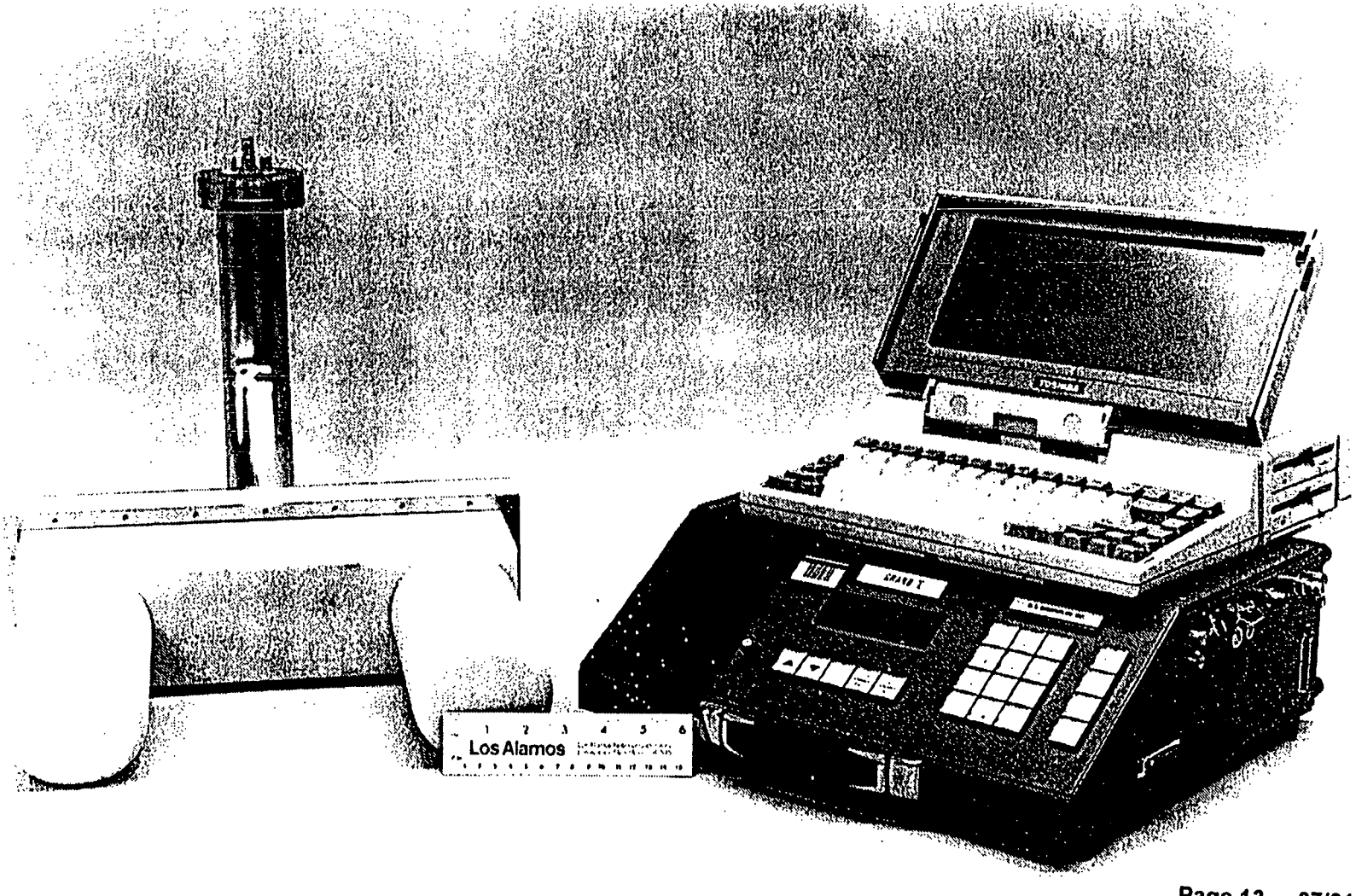
Example Loading Curve



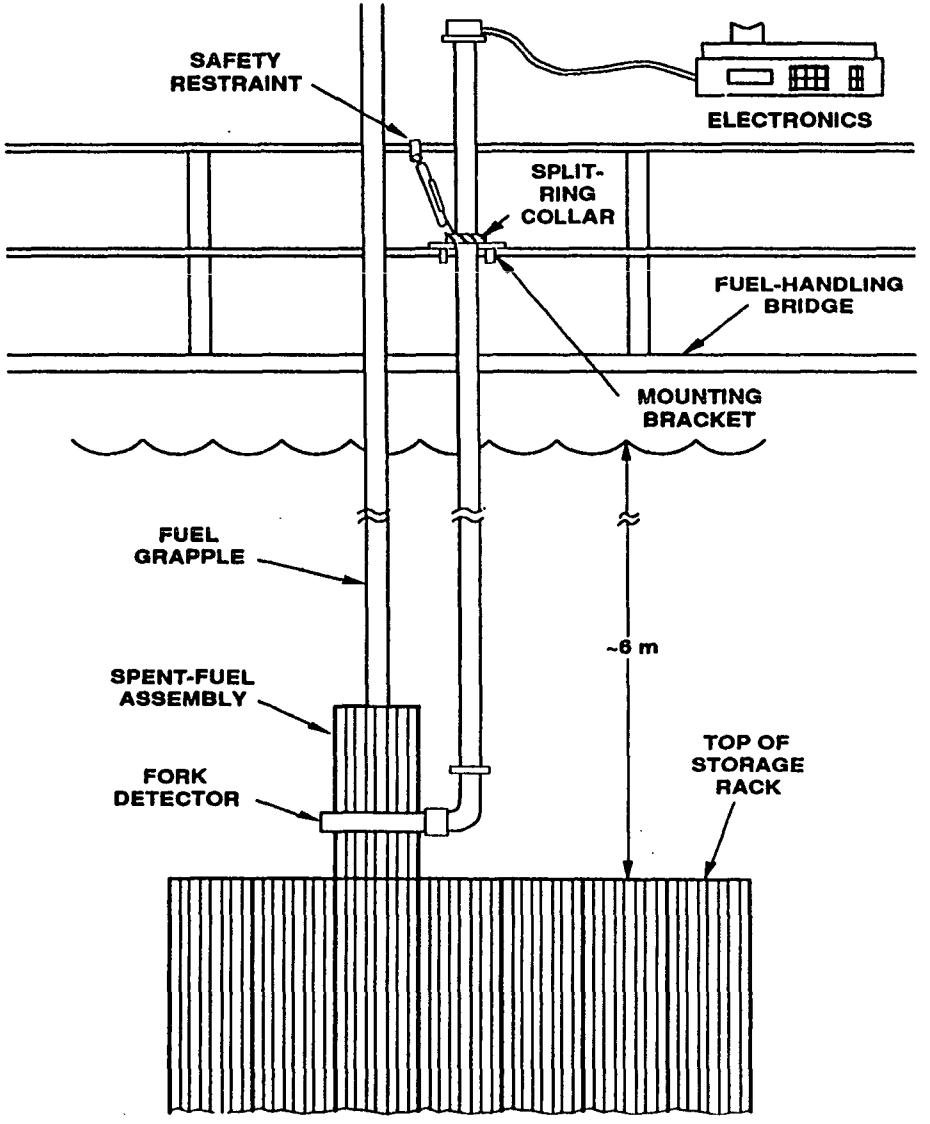
Burnup Verification

- OCRWM has identified a measurement device suitable for verifying proper loading of a burnup credit cask
- The "FORK" detector has been used by IAEA in safeguards applications to verify nuclide inventories
- The "FORK" detector is a passive device that measures gross neutrons and gross gammas
- Testing performed at nuclear utilities

Fork Detector & Control Electronics

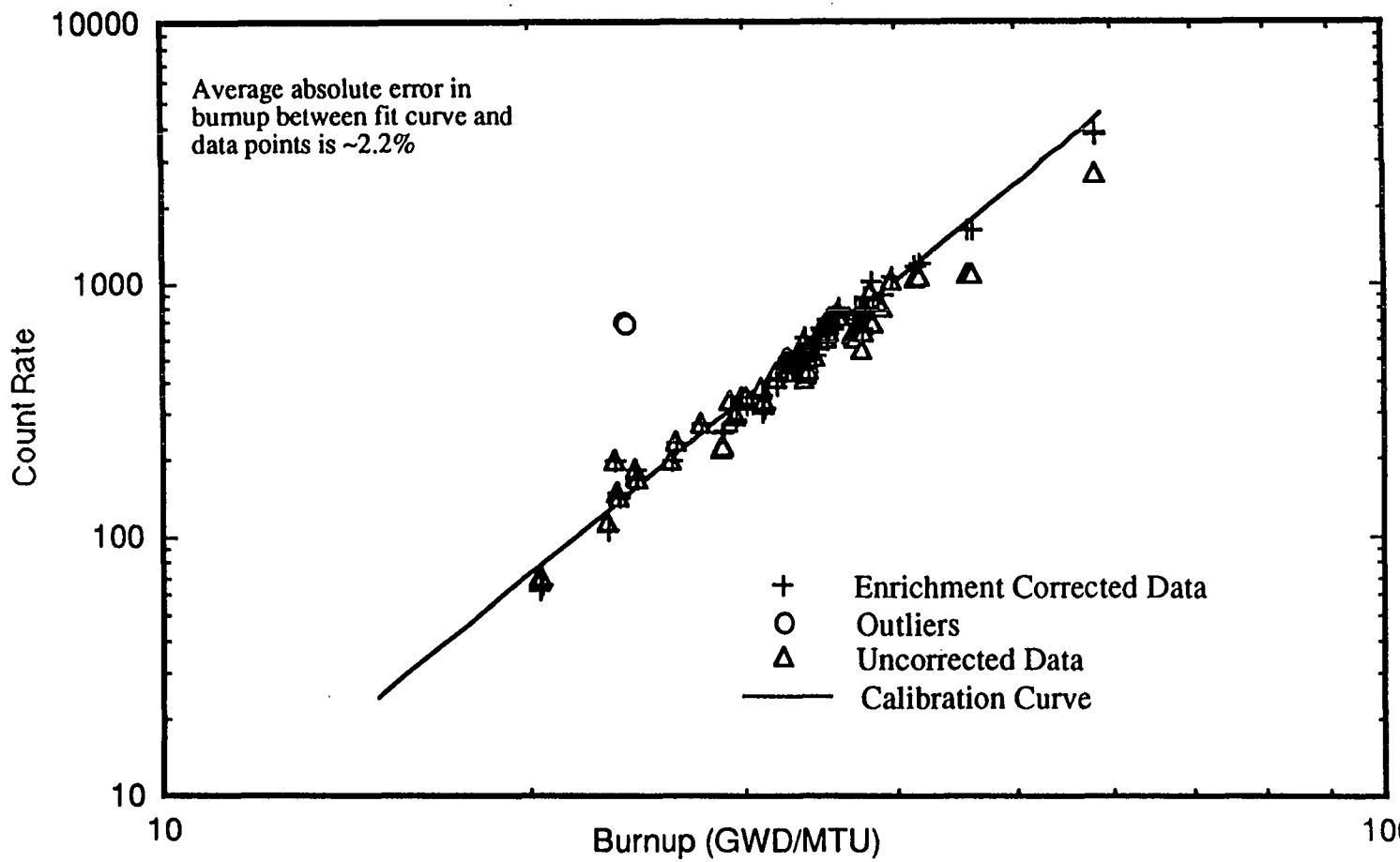


FORK Detector Schematic



Burnup Meter Measurements Oconee Nuclear Station

(data extrapolated to date of discharge using $T_{1/2}$ = 18y)



Summary

- Key technical issues related to burnup credit have been identified
- NRC will review and approve any use of burnup credit by OCRWM
- Burnup credit can be used without reducing safety
- Burnup credit can eliminate the need for flux traps thereby increasing capacity

Schedule

- DOE submit topical report - September 1994
- Approval of burnup credit topical report - Late 1995
- MPC vendors submit SARs - Early 1996
- DOE submit topical report on burnup credit for disposal of PWR/BWR spent fuel - 1996