U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: WASTE PACKAGE DESIGN REQUIREMENTS

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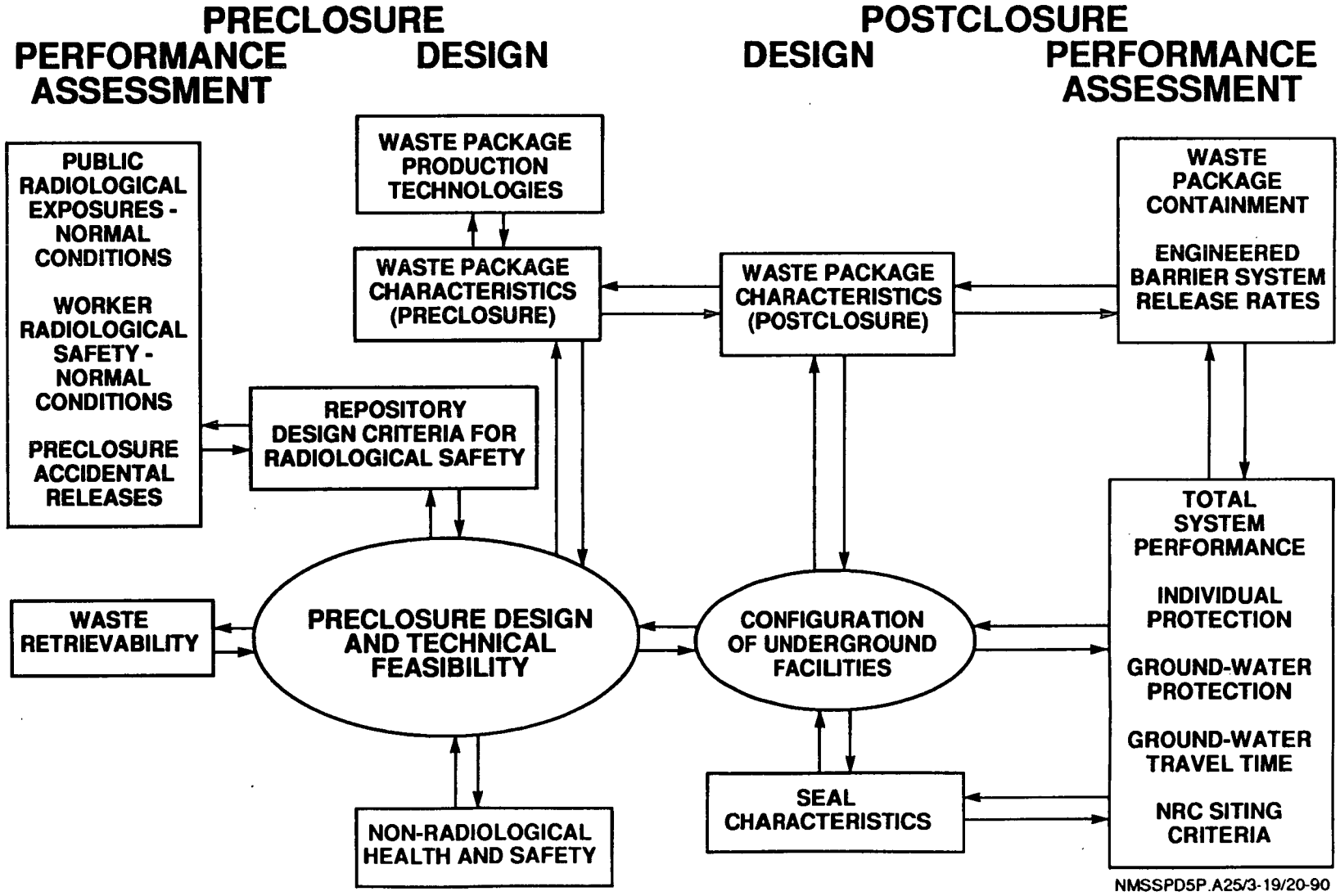
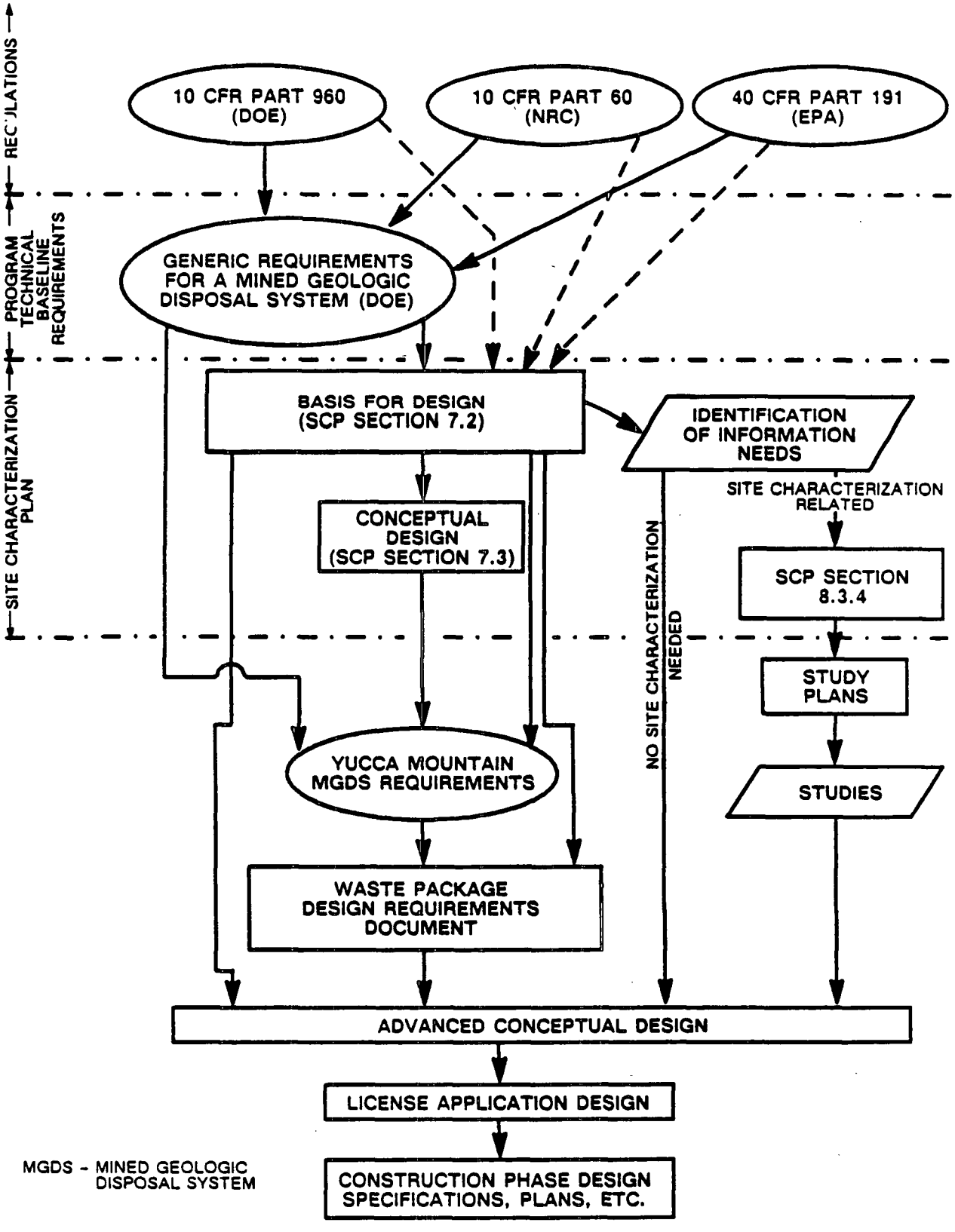
RELATIONSHIP BETWEEN DESIGN AND PERFORMANCE RELATED ISSUES



RELATIONSHIP OF DESIGN-RELATED DOCUMENTS FOR THE WASTE PACKAGE



MGDS - MINED GEOLOGIC DISPOSAL SYSTEM

NMDCR5P.A24/3-19/20-90 2

NUCLEAR REGULATORY COMMISSION REQUIREMENTS IN 10 CFR 60

60.113 REQUIRES FOR "ANTICIPATED PROCESSES AND EVENTS"

- "SUBSTANTIALLY COMPLETE" CONTAINMENT OF THE HLW WITHIN THE WASTE PACKAGES FOR A PERIOD OF 300 TO 1,000 YEARS AFTER REPOSITORY CLOSURE
- FOLLOWING THE CONTAINMENT PERIOD, CONTROL RELEASE FROM THE ENGINEERED BARRIER SYSTEM TO A RATE NOT TO EXCEED 1 PART IN 100,000 OF THE 1,000-YEAR INVENTORY PER NUCLIDE PER YEAR

60.135 REQUIRES THAT INDIVIDUAL COMPONENTS OR PROPERTIES NOT COMPROMISE THE OVERALL WASTE PACKAGE, REPOSITORY, OR SITE PERFORMANCE; AND SETS SPECIFIC STANDARDS SUCH AS REQUIRING A SOLID WASTE FORM AND SEALED CONTAINERS

DESIGN CRITERIA (60.135a)

- PACKAGES DESIGNED SO THAT IN SITU CHEMICAL, PHYSICAL & NUCLEAR PROPERTIES AND INTERACTIONS WITH EMPLACEMENT ENVIRONMENT DO NOT COMPROMISE PACKAGE FUNCTION OR REPOSITORY PERFORMANCE

- DESIGN MUST CONSIDER FOLLOWING FACTORS:
  - SOLUBILITY
  - OXIDATION/REDUCTION
  - CORROSION
  - HYDRIDING
  - GAS GENERATION
  - THERMAL EFFECTS
  - THERMAL LOADS
  - MECHANICAL STRENGTH
  - MECHANICAL STRESS
  - RADIOLYSIS
  - RADIATION DAMAGE
  - RADIONUCLIDE RETARDATION
  - LEACHING
  - FIRE AND EXPLOSION HAZARDS
  - SYNERGISTIC INTERACTIONS

KEY WASTE PACKAGE INTERFACES

WASTE GENERATORS, INCLUDING UTILITIES, AND DOE DEFENSE ACTIVITIES

- RECEIPT STREAM CHARACTERISTICS (TIME-DEPENDENT)

OR

MRS

- IF IT ACTS AS A MODULATOR OF SPENT FUEL CHARACTERISTICS

REPOSITORY

- SURFACE FACILITY
  - ASSEMBLY FACILITY FOR WASTE PACKAGE
- SUBSURFACE FACILITY
  - PHYSICAL LAYOUT & DIMENSIONS
  - OPERATIONS AFFECTING PERFORMANCE
  - EBS COMPONENTS

KEY WASTE PACKAGE INTERFACES

(CONTINUED)

SITE

- PRE-EMPLACEMENT ROCK PROPERTIES
  - THERMAL
  - MECHANICAL
- HYDROLOGIC PROPERTIES
  - VADOSE WATER COMPOSITION
  - FLUX
  - SATURATION
- THERMALLY-PERTURBED RESPONSES

DESIGN REQUIREMENTS/GOALS

THERMAL

- PEAK CLADDING TEMPERATURE (SPENT FUEL)
  <350° C
- PEAK EMPLACEMENT HOLE WALL
  <275° C
- MAINTAIN EMPLACEMENT HOLE WALL
  >95° C (UNCONFINED BOILING POINT)
  AS LONG AS PRACTICABLE
- ROCK @ 1 m FROM EMPLACEMENT HOLE
  <200° C

THERMAL CONSIDERATIONS

WASTE FORM TEMPERATURES

- SPENT FUEL CLADDING DEGRADATION
- SPENT FUEL OXIDATION RATES
- RADIONUCLIDE RELEASE RATES

CONTAINER TEMPERATURES

- DEGRADATION MODES (OXIDATION vs AQUEOUS CORROSION)
- DEGRADATION RATES

BOREHOLE WALL TEMPERATURES

- TRANSPORT MEDIUM - VAPOR/LIQUID
- BOREHOLE STABILITY
- MINERALOGIC ALTERATIONS

NEAR-FIELD TEMPERATURES

- RADIONUCLIDE TRANSPORT MECHANISMS
- RADIONUCLIDE TRANSPORT RATES