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

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: CASK TESTING

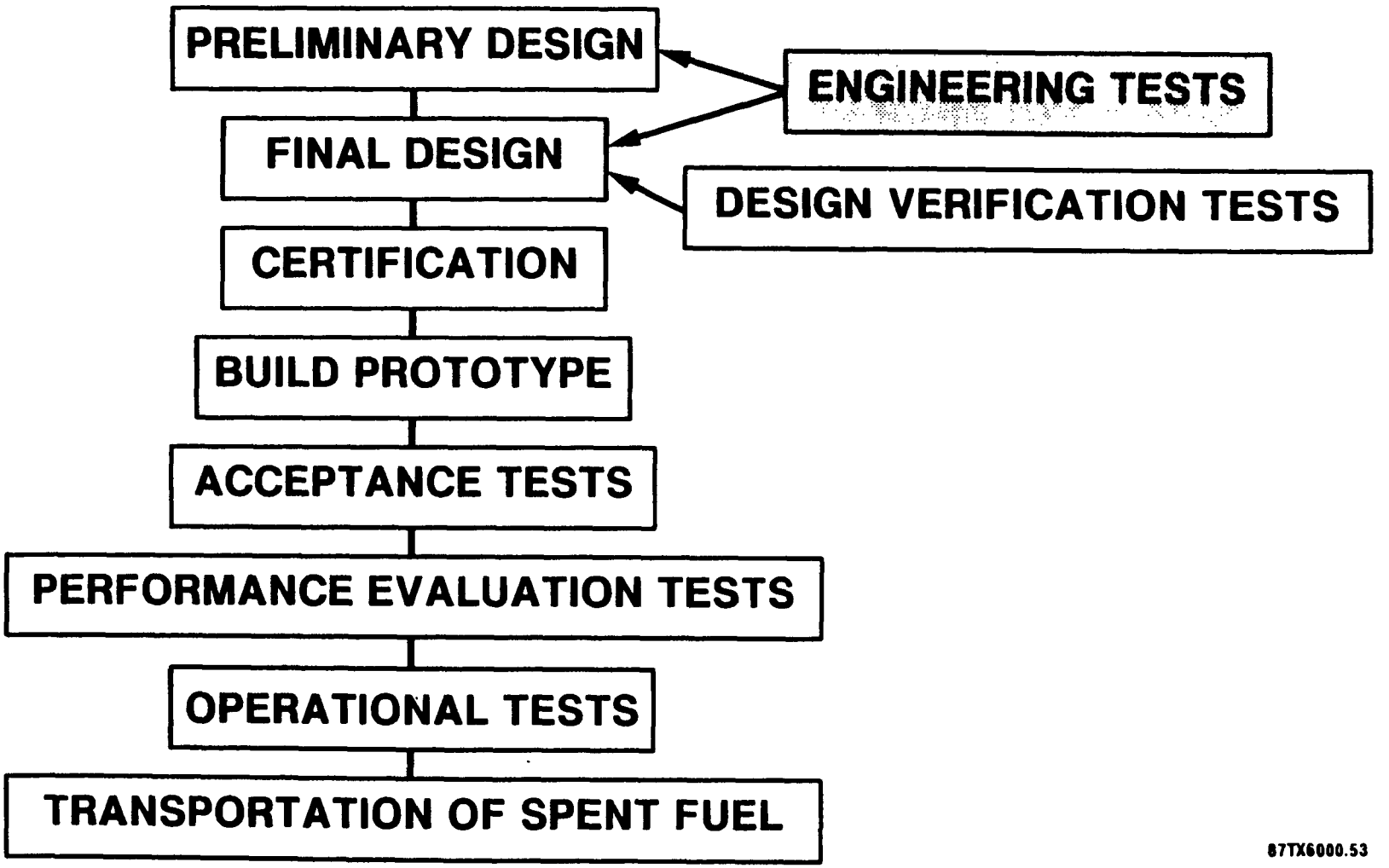
PRESENTER: MARILYN WARRANT

PRESENTER'S TITLE AND ORGANIZATION:
SUPERVISOR
TRANSPORTATION SYSTEMS DEVELOPMENT DIVISION
SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NM

PRESENTER'S TELEPHONE NUMBER: (505) 844-6618

AUGUST 21, 1989

PROCESS FOR DEVELOPING A SPENT FUEL CASK



87TX6000.53

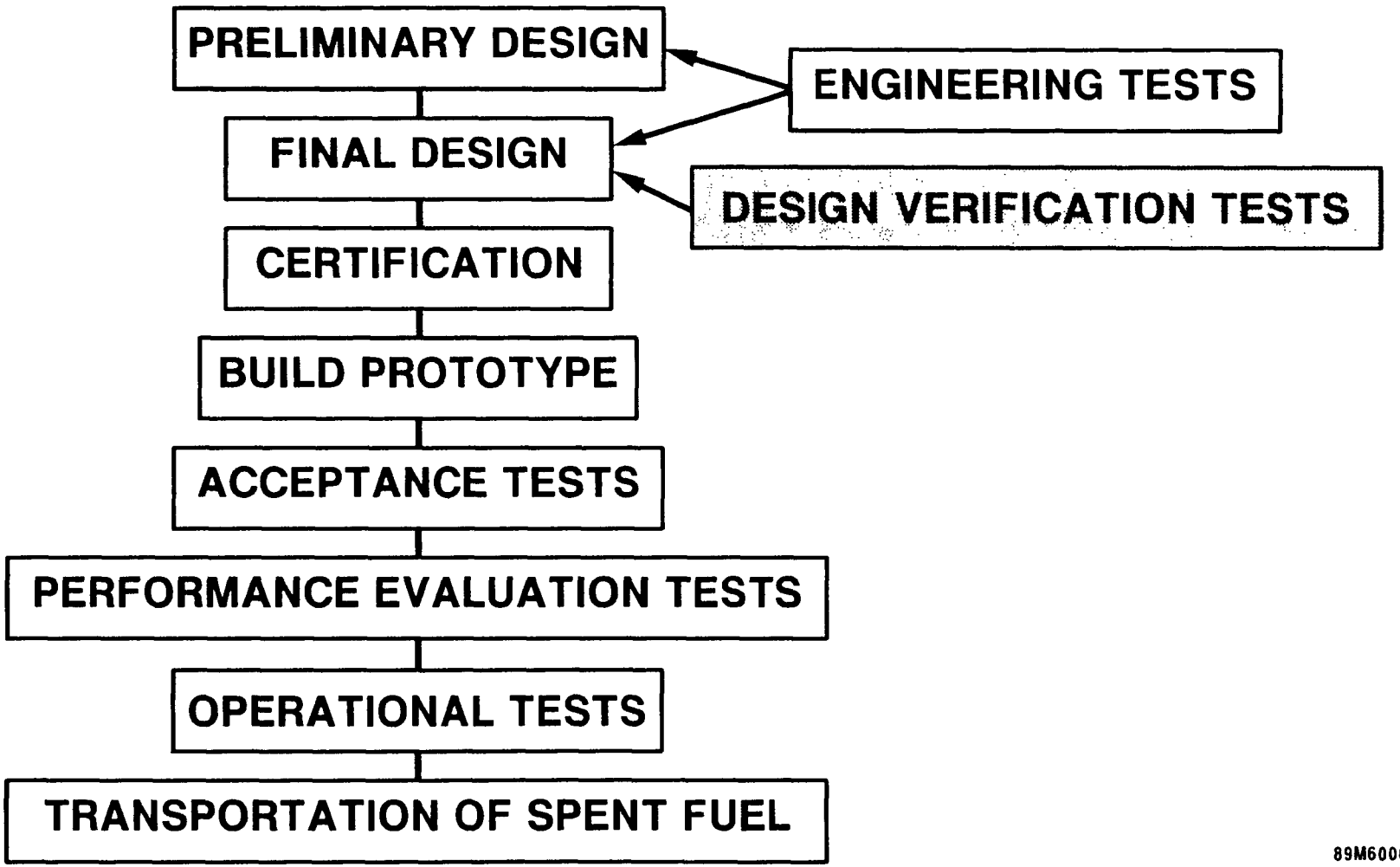
ENGINEERING TESTING

ENGINEERING TESTING YIELDS DATA ON COMPLEX BEHAVIOR OF MATERIALS AND COMPONENTS.

EXAMPLES ARE:

- TEMPERATURE PERFORMANCE OF A SEAL
- ENERGY ABSORPTION OF AN IMPACT LIMITER
- MATERIAL PROPERTIES

PROCESS FOR DEVELOPING A SPENT FUEL CASK



89M6000.63

INTEGRATION OF ANALYSIS AND SCALE MODEL TESTING

- ANALYTIC ASSUMPTIONS VERIFIED
  - MATERIAL MODELS
  - BOUNDARY CONDITIONS
- ANALYTICAL MODELS MODIFIED TO CORRESPOND WITH OBSERVED BEHAVIOR OF SCALE MODELS
- PACKAGE RESPONSE ANALYZED FOR NORMAL AND HYPOTHETICAL ACCIDENT ENVIRONMENTS NOT TESTED

SCALING RELATIONSHIPS FOR STRUCTURAL TESTS

DISPLACEMENT: $L_{model} = 1/n \cdot L_{full\text{-}scale}$

ACCELERATION: $a_{model} = n \cdot a_{full\text{-}scale}$

FORCE: $F_{model} = (1/n)^2 \cdot F_{full\text{-}scale}$

VELOCITY: $V_{model} = V_{full\text{-}scale}$

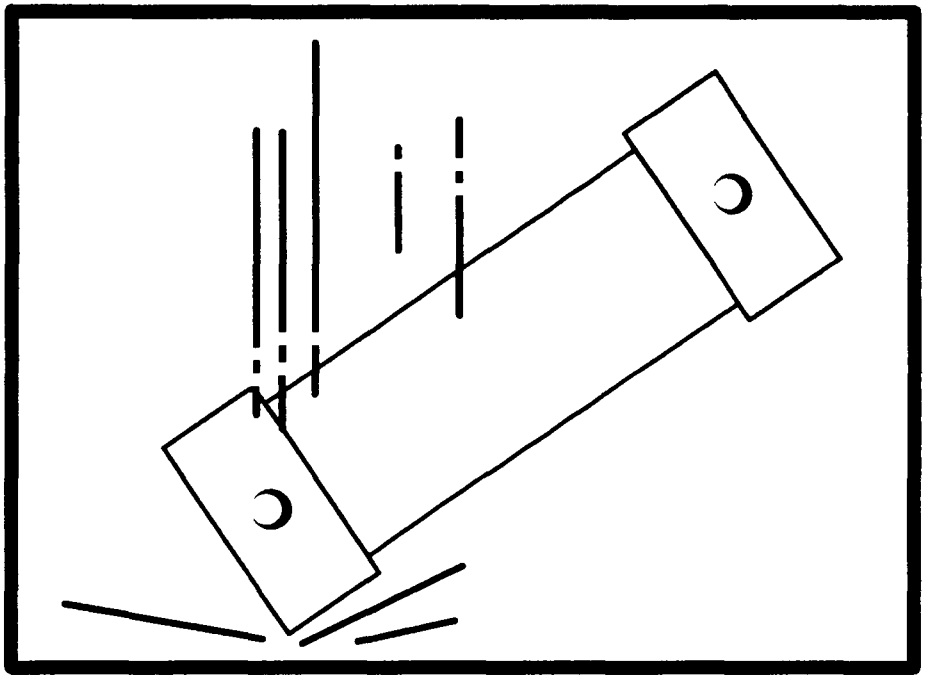
STRESS: $\sigma_{model} = \sigma_{full\text{-}scale}$

STRAIN: $\varepsilon_{model} = \varepsilon_{full\text{-}scale}$

WHERE $\frac{1}{n}$ **= SCALE OF MODEL**

87TX6000.38

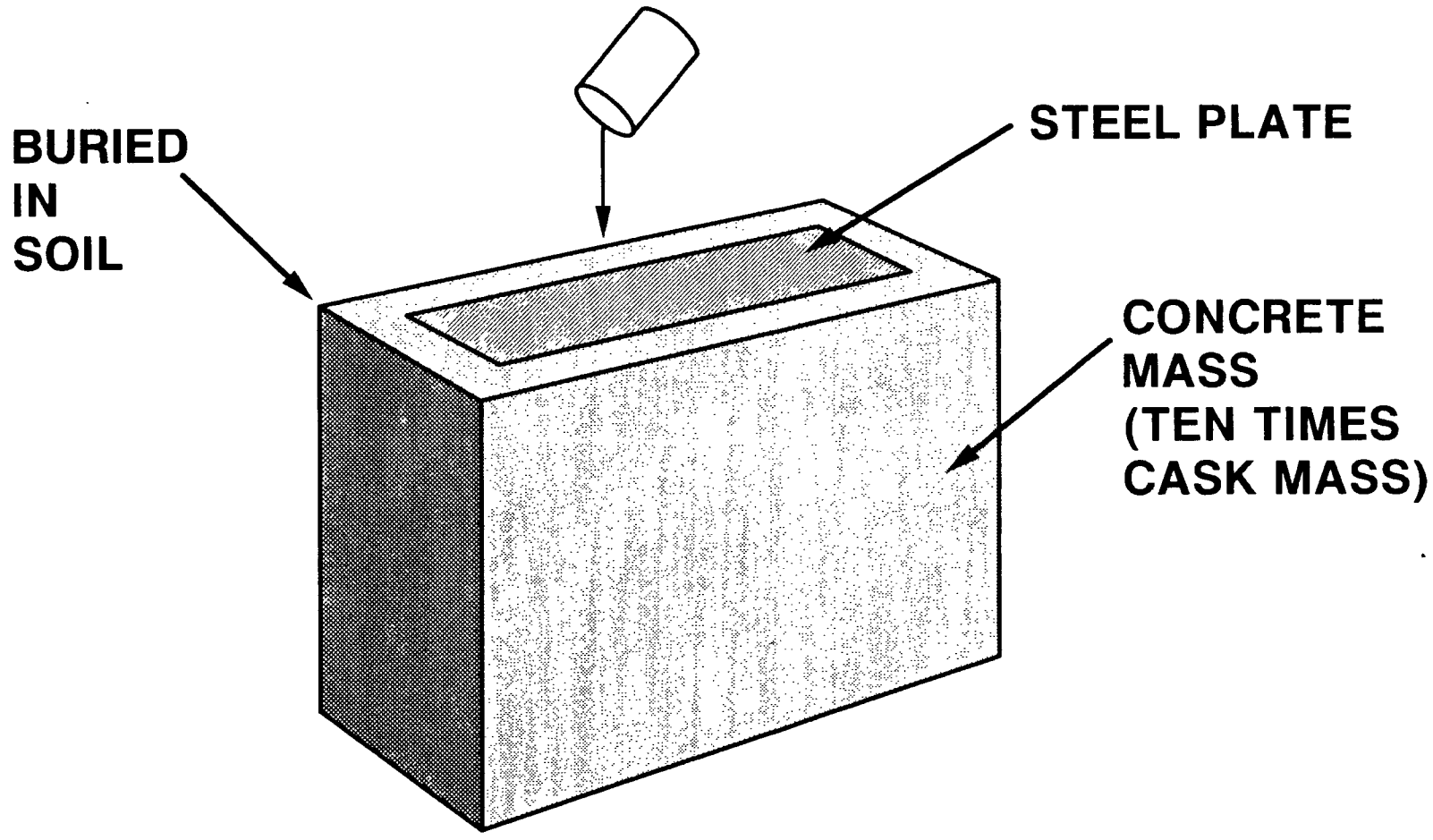
FREE DROP TEST



THIRTY FOOT FREE DROP ONTO A FLAT, ESSENTIALLY UNYIELDING HORIZONTAL SURFACE IN A POSITION FOR WHICH MAXIMUM DAMAGE IS EXPECTED

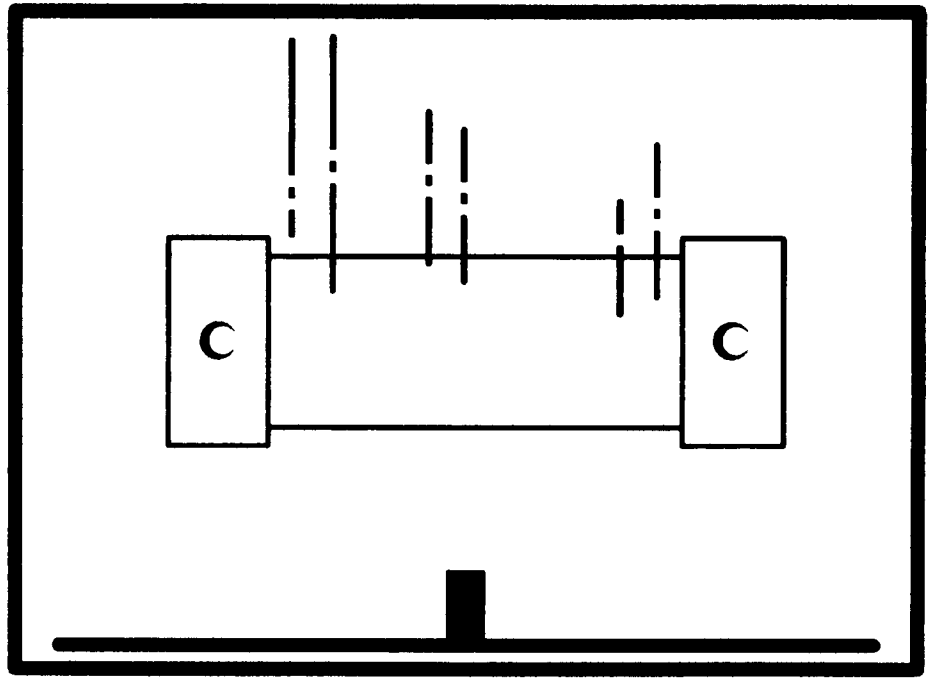
87TX6000.72

UNYIELDING TARGET FOR TESTS



86TJ6000.25

PUNCTURE TEST



FORTY INCH FREE DROP ONTO A 6 INCH DIAMETER MILD STEEL BAR AT LEAST 8 INCHES LONG IN A POSITION FOR WHICH MAXIMUM DAMAGE IS EXPECTED.

87TX6000.73

TYPES OF DATA COLLECTED FROM TESTING

- MECHANICAL MEASUREMENTS
- X-RAY EXAMINATIONS
- LEAKAGE TESTING
- HIGH SPEED PHOTOGRAPHY
- INSTRUMENTATION DATA
  - ACCELERATIONS
  - STRAINS
  - TEMPERATURES

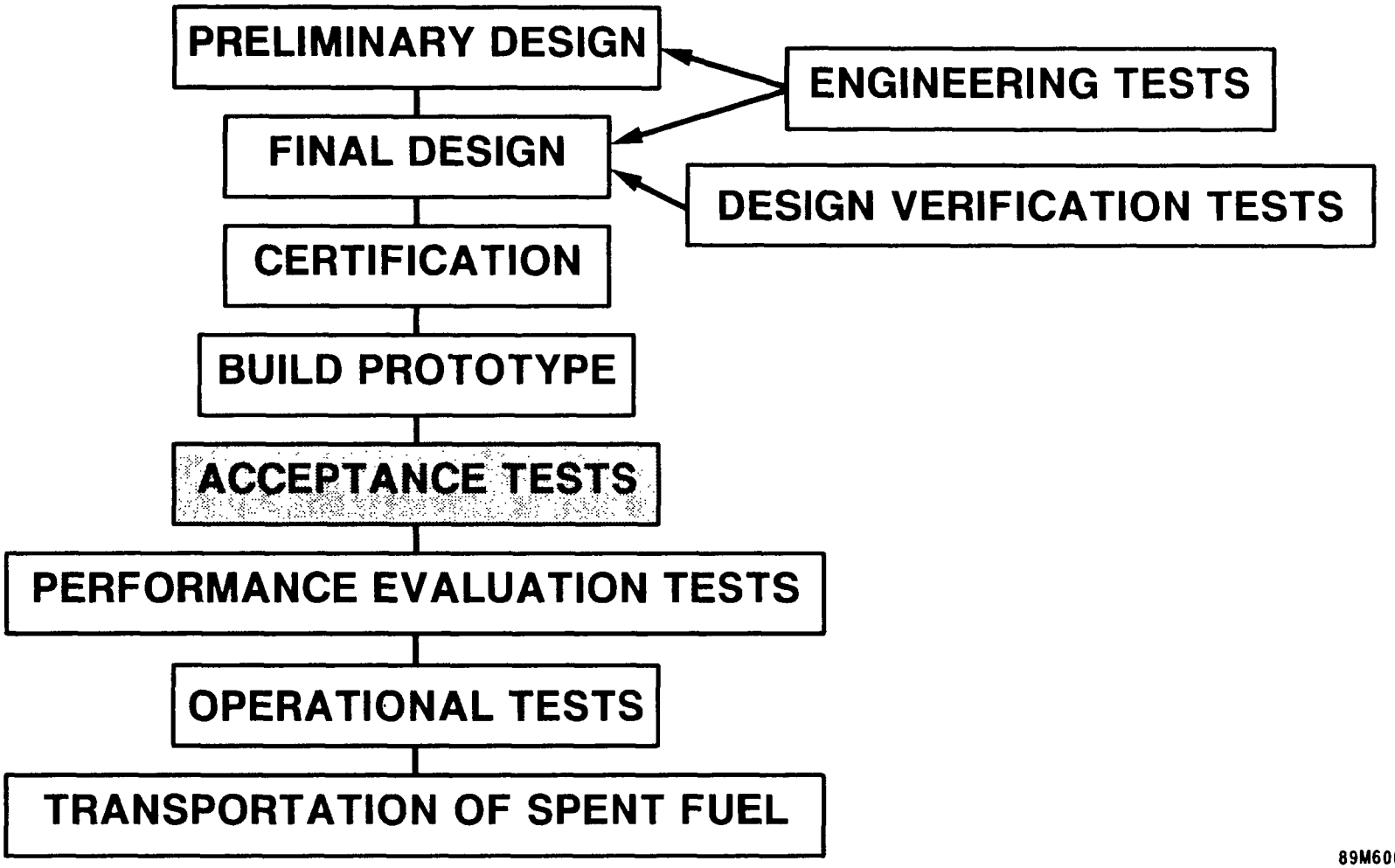
87TX6000.39

IN GENERAL
THERMAL TESTS DO NOT SCALE

- THERE ARE 11 INDEPENDENT DIMENSIONLESS VARIABLES THAT MUST BE MATCHED FOR PERFECT SCALING OF A TRANSIENT TEST.

- THE TEST ARTICLE CAN AFFECT THE LOCAL THERMAL ENVIRONMENT

PROCESS FOR DEVELOPING A SPENT FUEL CASK



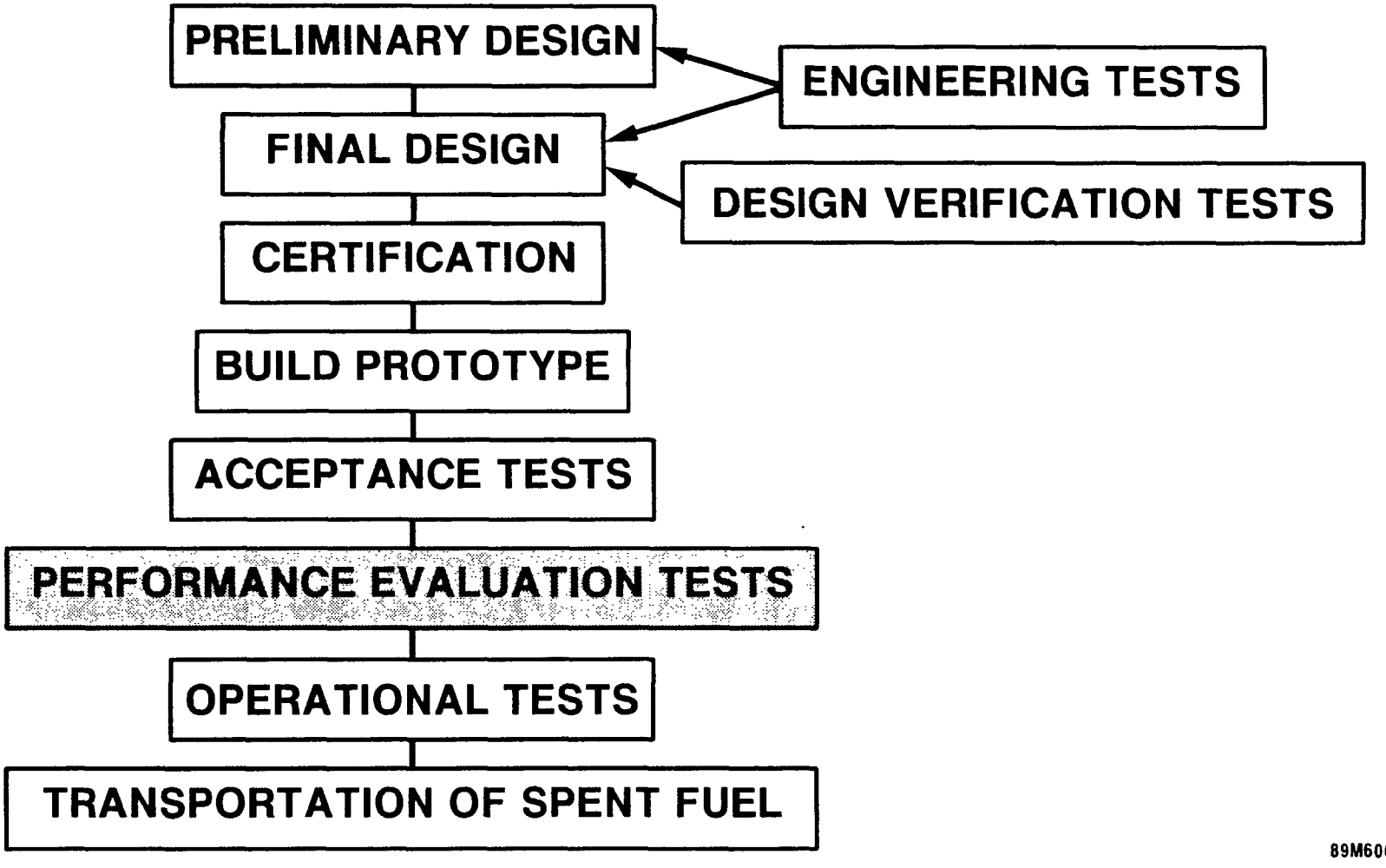
89M6000.62

ACCEPTANCE TESTING

ACCEPTANCE TESTS ARE NONDESTRUCTIVE EVALUATIONS PERFORMED ON EACH FULL SCALE PROTOTYPE TO ENSURE FABRICATION WAS IN ACCORDANCE WITH DESIGN SPECIFICATIONS IN THE SAFETY ANALYSIS FOR PACKAGING.

- COMPONENT FUNCTION
- VISUAL
- PRESSURE
- LEAKAGE
- SHIELDING
- THERMAL

PROCESS FOR DEVELOPING A SPENT FUEL CASK



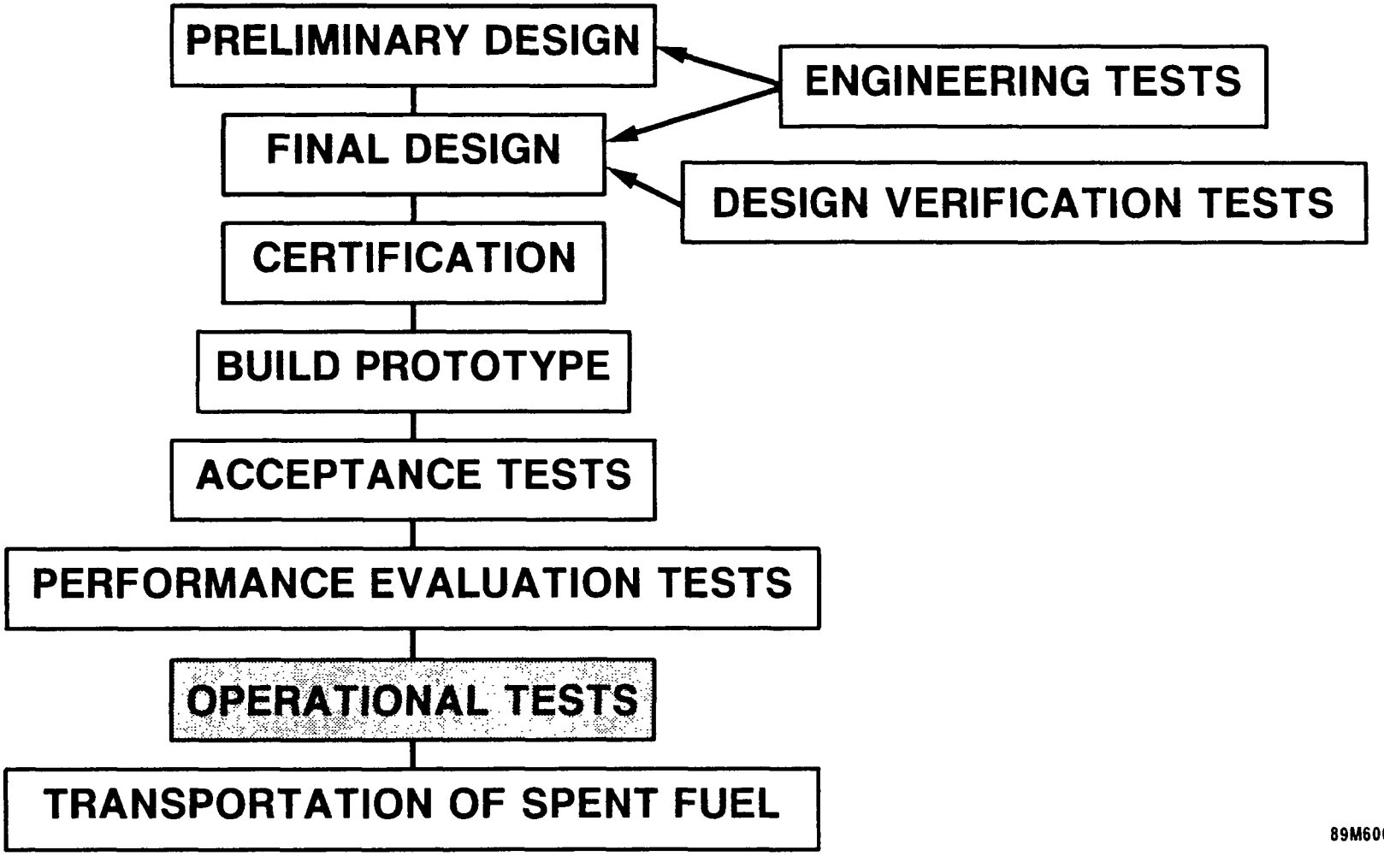
89M6000.61

PERFORMANCE EVALUATION TESTING
(AT ONE FACILITY)

- DETERMINE IF PROTOTYPE PERFORMS AS INTENDED
  - TRANSPORT
  - INTERMODAL TRANSFER
  - TRANSPORTER LOADING / UNLOADING
  - SPENT (OR SIMULATED) FUEL LOADING / UNLOADING
  - LEAKAGE TESTING
  - DECONTAMINATION
  - MANUAL AND AUTOMATED HANDLING
- OBTAIN SHIPPING AND HANDLING DATA FOR LIFE CYCLE COST EVALUATIONS
- IDENTIFY POTENTIAL IMPROVEMENTS, AND MODIFY DESIGN (IF NECESSARY) BEFORE OPERATIONAL TESTING

89N6000.01

PROCESS FOR DEVELOPING A SPENT FUEL CASK



89M6000.64

OPERATIONAL TESTING
(AT NUMEROUS FACILITIES)

- INTEGRATE EACH CASK SYSTEM INTO TRANSPORTATION SYSTEM
- ESTABLISH OPERATIONAL CHARACTERISTICS
  - EVALUATE EQUIPMENT
  - TEST DETAILED PROCEDURES
  - DEMONSTRATE INTERCHANGEABLE COMPONENTS
  - DEFINE SITE-SPECIFIC INTERFACE REQUIREMENTS, PROCEDURES, TRAINING PROGRAMS
- IDENTIFY POTENTIAL IMPROVEMENTS, MODIFY DESIGN (IF NECESSARY) BEFORE FLEET PROCUREMENT

SUMMARY OF TESTING OBJECTIVES

- VERIFY ENGINEERING DESIGN ANALYSIS
- REDUCE UNCERTAINTIES IN CASK DESIGN
- EXPEDITE THE CERTIFICATION PROCESS
- ASSIST IN PUBLIC UNDERSTANDING
- EVALUATE CASK PERFORMANCE

CONSIDERATIONS FOR CONFIRMATORY CASK TESTING

- TEST OF A FULL-SIZE "PROTOTYPE" SPENT FUEL CASK
- POSSIBLE REASONS FOR CONFIRMATORY CASK TESTING
  - CHANGED STATUTORY OR REGULATORY REQUIREMENTS
  - IN RESPONSE TO PUBLIC CONCERNS