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VIEW GRAPHS

ACCOMPANYING PRESENTATION

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SANDIA LABORATORIES

ON

EVOLUTION TO MELTDOWN

AND

REINTRODUCTION OF WATER

TO DAMAGED CORE

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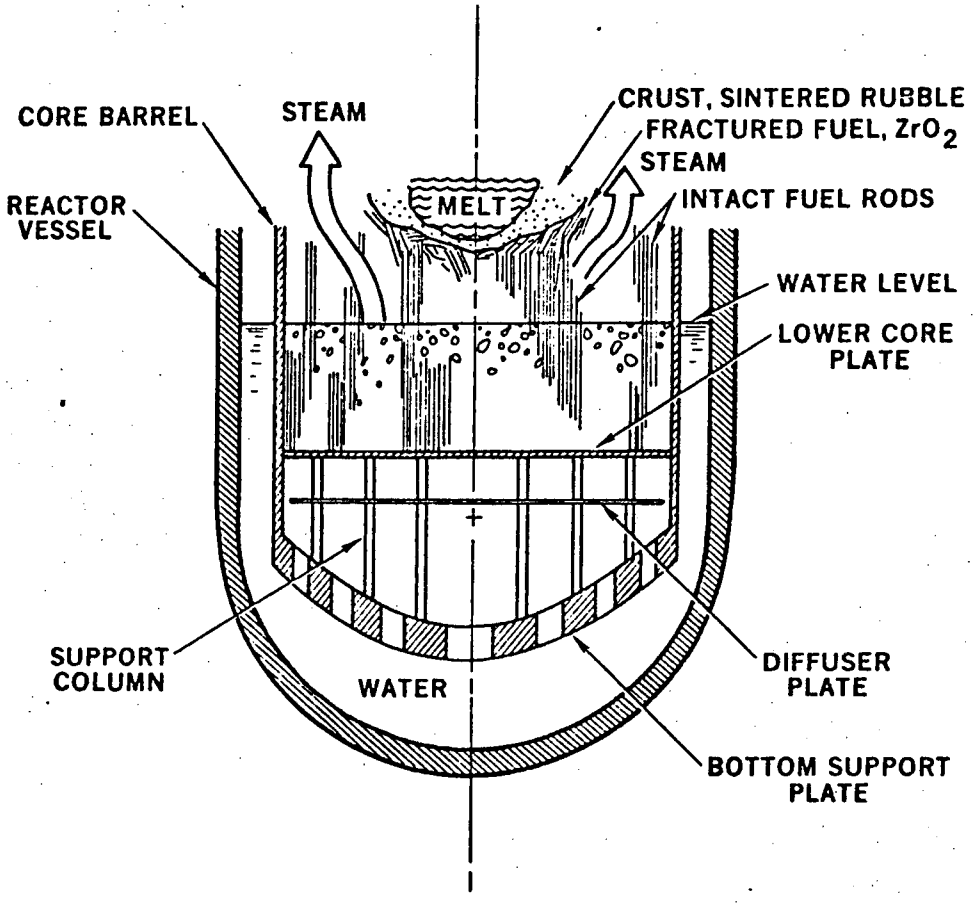
EVOLUTION TO MELTDOWN

- A PHENOMENOLOGICAL CHECKLIST -

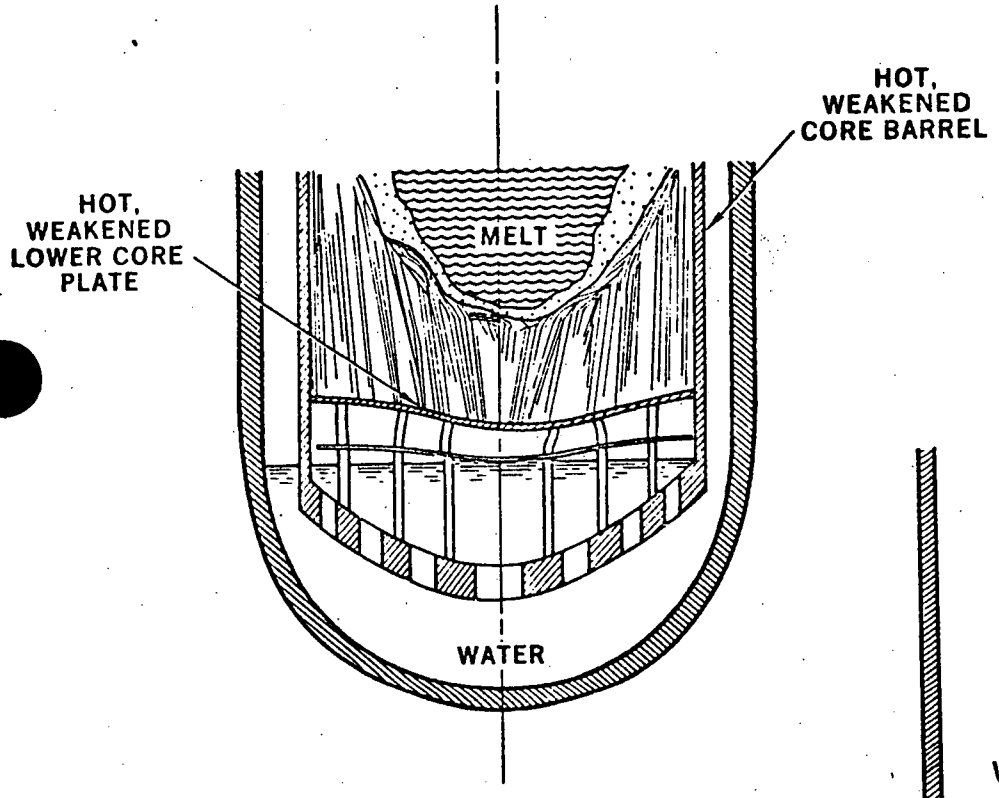
- VESSEL BOILOFF PRECURSORS (SEQUENCE DEPENDENT)
- BOILOFF FROM CORE REGION
- FUEL HEATUP
  - DECAY HEAT (F.P. LOSS AS DAMAGE INCREASES)
  - Zr/H_2O REACTION, H_2 GENERATION
  - HEAT LOSS BY VARIOUS MECHANISMS
  - CLAD DAMAGE (O EMBRITTLEMENT, ZrO_2 SPALLATION)
  - CLAD RELOCATION
  - FORMATION OF FUEL/CLAD RUBBLE POSSIBLE

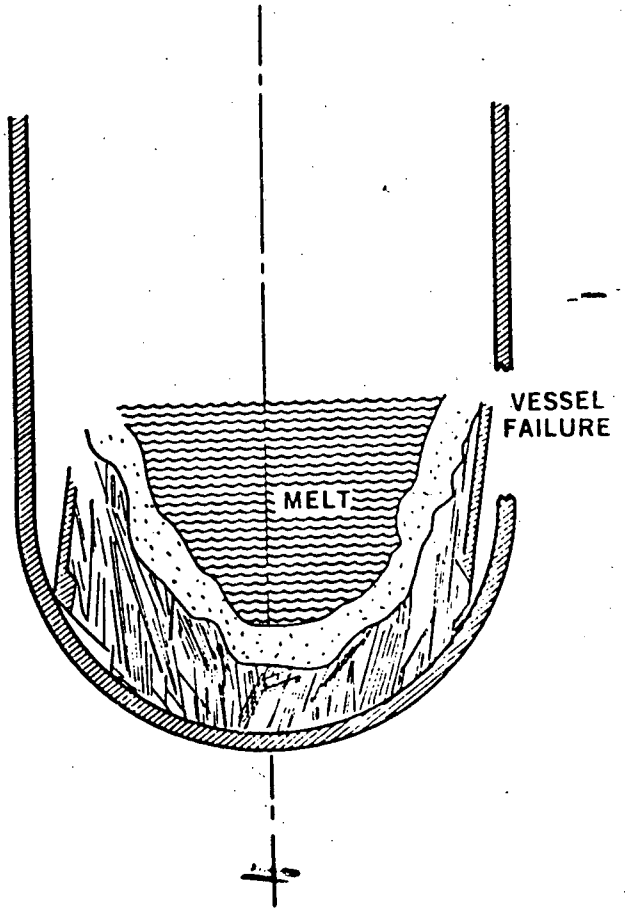
- FUEL MELT
  - FORMATION OF U-O-ZR MELTABLES
  - LOCAL MELT MOTION (RIVULET FLOW)
  - FREEZING, REMELT AT LOWER ELEVATIONS (BLOCKAGE?)
  - MELT STREAMING, QUENCHING (STEAM EXPLOSION?), FRAGMENTATION AND DISPERSION



- CORE MELT
  - FORMATION OF MOLTEN POOL (CRUST STABILITY)
  - STRUCTURAL HEATUP AND MELT-IN OF STEEL
  - POOL CRUST FAILURE (STREAMING) OR CORE SLUMPING TO LOWER PLENUM

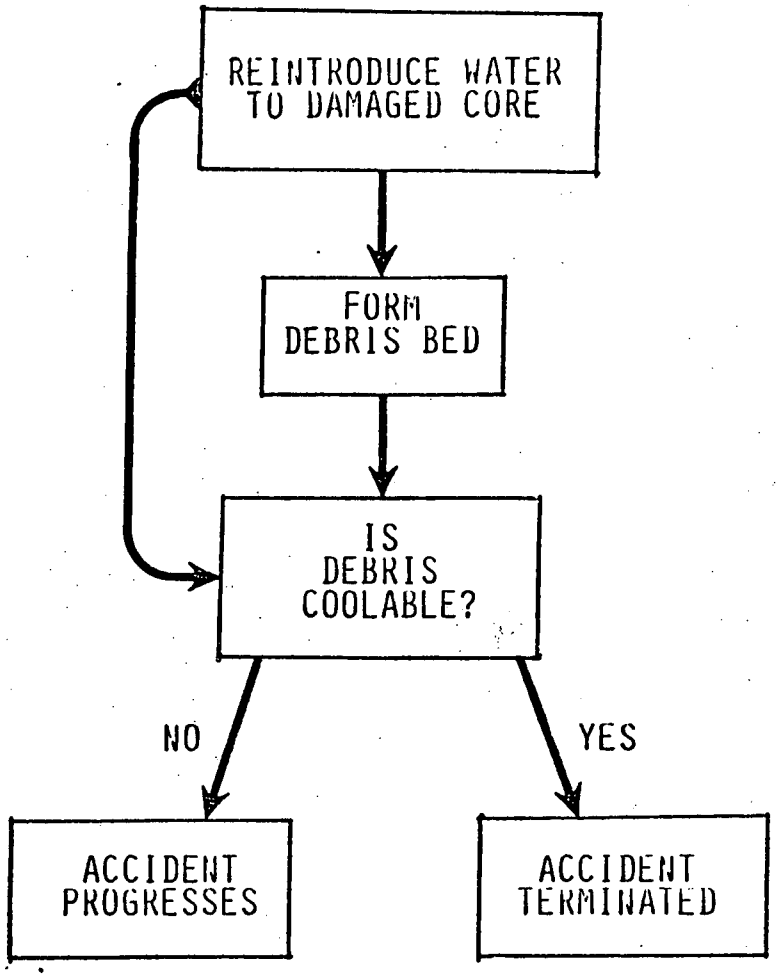
- LOWER PLENUM
  - FAILURE OF BELOW-CORE STRUCTURES
  - MELT/WATER INTERACTIONS IN LOWER PLENUM (QUENCHING, S. EXPLOSION, DEBRIS BED FORMATION)
  - VAPORIZATION OF REMAINING WATER
  - ATTACK OF PRESSURE VESSEL
  - BREACH OF RPV AND EXIT OF CORE MATERIALS





PHENOMENOLOGICAL UNCERTAINTIES

- <u>EARLY</u>
  - CLAD FRACTURE AND RELOCATION MODES
  - FISSION PRODUCT REDISTRIBUTION
  - EARLY U-O-Zr MELTABLES (MPs, BEHAVIOR, PROPERTIES)
  - FAILURE MODES OF INTERNAL STRUCTURES (EFFECT ON SEQUENCE)
  - BLOCKAGE EFFECTS (HEAT TRANSFER, EXTENT OF H_2O/Zr REACTION)
  - MELT MOTION (STREAMING, REFREEZING, COHERENCY)
- <u>LATE</u>
  - CRUST (FORMATION, STRENGTH, REMELT)
  - OCCURRENCE OF STEAM EXPLOSIONS
  - MELT-WATER INTERACTIONS (DEGREE OF FRAGMENTATION, DISPERSAL POTENTIAL, TYPE OF DEBRIS BEDS FORMED)
  - DEBRIS COOLABILITY
  - VESSEL FAILURE MODE(S) AND TIMING


REINTRODUCE WATER TO DAMAGED CORE
FORM DEBRIS BED
IS DEBRIS COOLABLE?
NO
YES
ACCIDENT PROGRESSES
ACCIDENT TERMINATED

UNCERTAINTIES FOLLOWING REINTRODUCTION OF WATER INTO DAMAGED CORE

EARLY (PREMELT) DEBRIS

- TYPE AND EXTENT OF DAMAGE
  - OXIDIZED CLAD
  - BALLOONED CLAD
  - FRACTURED CLAD + PELLETS
- LOCATION OF DEBRIS
  - IN-PLACE
  - RUBBLE HEAP
  - SETTLED INTO UNDAMAGED CORE
- GEOMETRY OF DEBRIS
  - FRACTURE OR FRAGMENT SIZES
  - PACKING
- EFFECTS OF WATER ENTRY
  - HEAT TRANSFER
  - HYDRODYNAMIC EFFECTS

UNCERTAINTIES FOLLOWING REINTRODUCTION OF WATER INTO DAMAGED CORE

LATE (MOLTEN) DEBRIS

- TYPE AND EXTENT OF MELT
  - SIZE, ENTHALPY ABOVE MELT
  - DEGREE OF COHERENCY
- LOCATION OF MELT
  - BLOCKAGES (WATER ACCESS)
  - AXIAL PENETRATION
- EFFECTS OF WATER ENTRY
  - STEAM EXPLOSION, DAMAGE
  - MELT QUENCH, FRAGMENTATION
  - DISPERSAL OF DEBRIS
- DEBRIS BED
  - FORMATION (STRATIFIED?)
  - COOLING
  - REMELT