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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
PANEL ON THE ENGINEERED BARRIER SYSTEM

SUBJECT: PLAN FOR STUDY OF SYSTEM IMPLICATIONS OF REPOSITORY THERMAL LOADING

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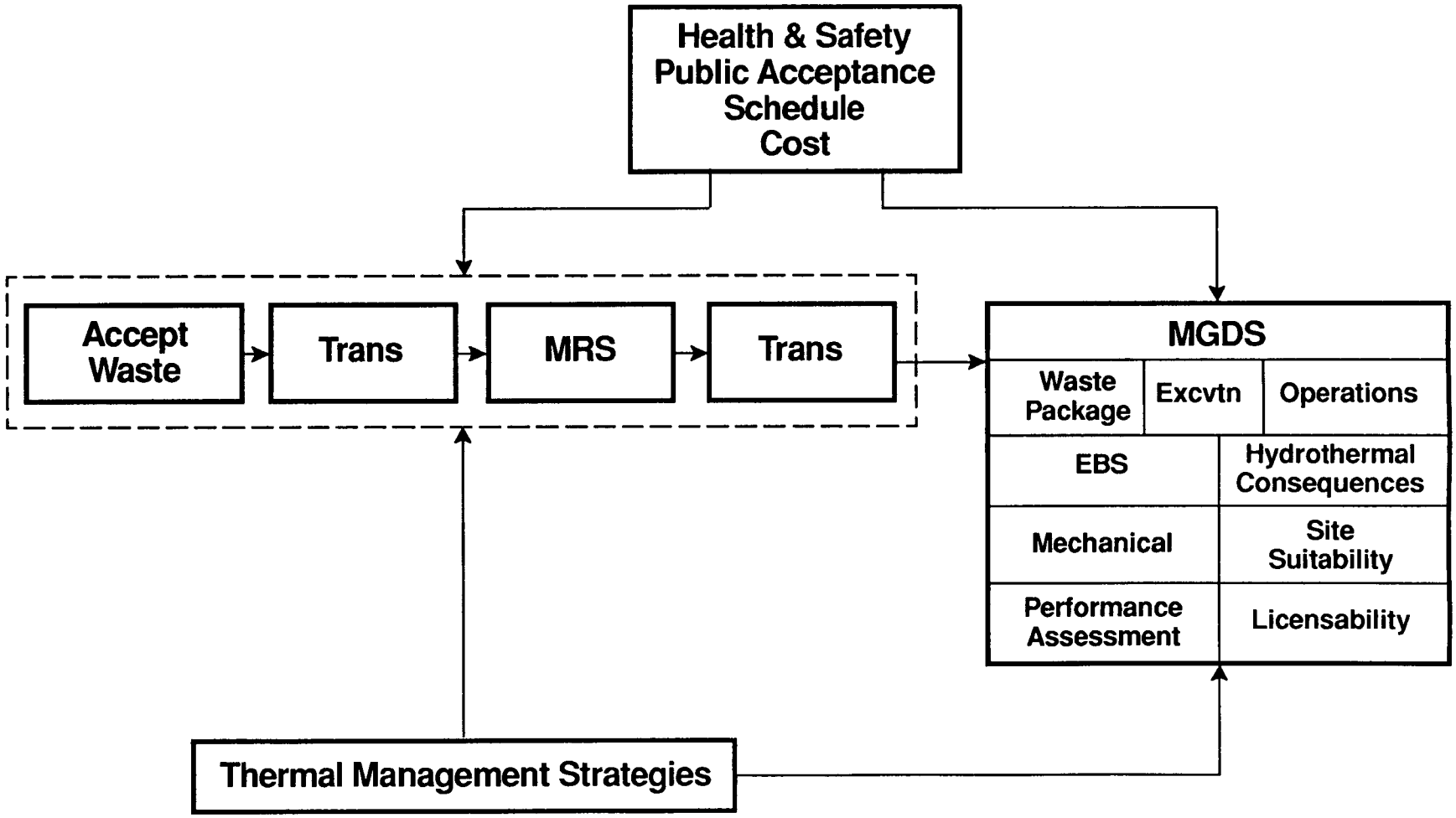
Reasons for Study

- Several CRWMS repository thermal management strategies for assuring licensability have been independently proposed
- Implementation of any of these strategies will impact design and operational functions of each of the other components of the CRWMS, particularly near-term decisions needed by MRS and transportation design
- Selection of a thermal management strategy must reflect the evaluation of these system impacts, as well as the MGDS issues of performance assessment and licensability

Study Context



Study Objectives

- Identify feasible system scenarios (all events through pre-closure), which can support the thermal management strategy
- Analyze the system level impacts of the proposed range of thermal management strategies
- Identify additional program-critical milestones, which may be impacted by selection of a thermal management strategy
- Provide design basis information and trade-offs for CRWMS requirements generation and design activities

Overall Study Approach

Study to be conducted in two phases

Phase I: SCENARIO FEASIBILITY ASSESSMENT (FY 92)

- Review prior work; identify impacted program decisions
- Establish thermal management strategies
- Define analysis methodology and system scenario feasibility screening criteria
- Generate candidate system scenarios, including MGDS emplacement
- Identify major system impacts
- Evaluate individual scenario feasibilities
- Present options to decision-makers

Overall Study Approach

(CONTINUED)

Phase II: IMPACT ANALYSIS (FY 93)

- Use performance assessment and licensability focus to refine thermal strategies
- Refine system scenarios to support refined thermal strategies
- Assess impacts on site characterization requirements
- Establish evaluation criteria and measures of effectiveness (MOEs)
- Propose alternative strategy/scenario options reflecting refined evaluations, including risk

Phase I Study Approach

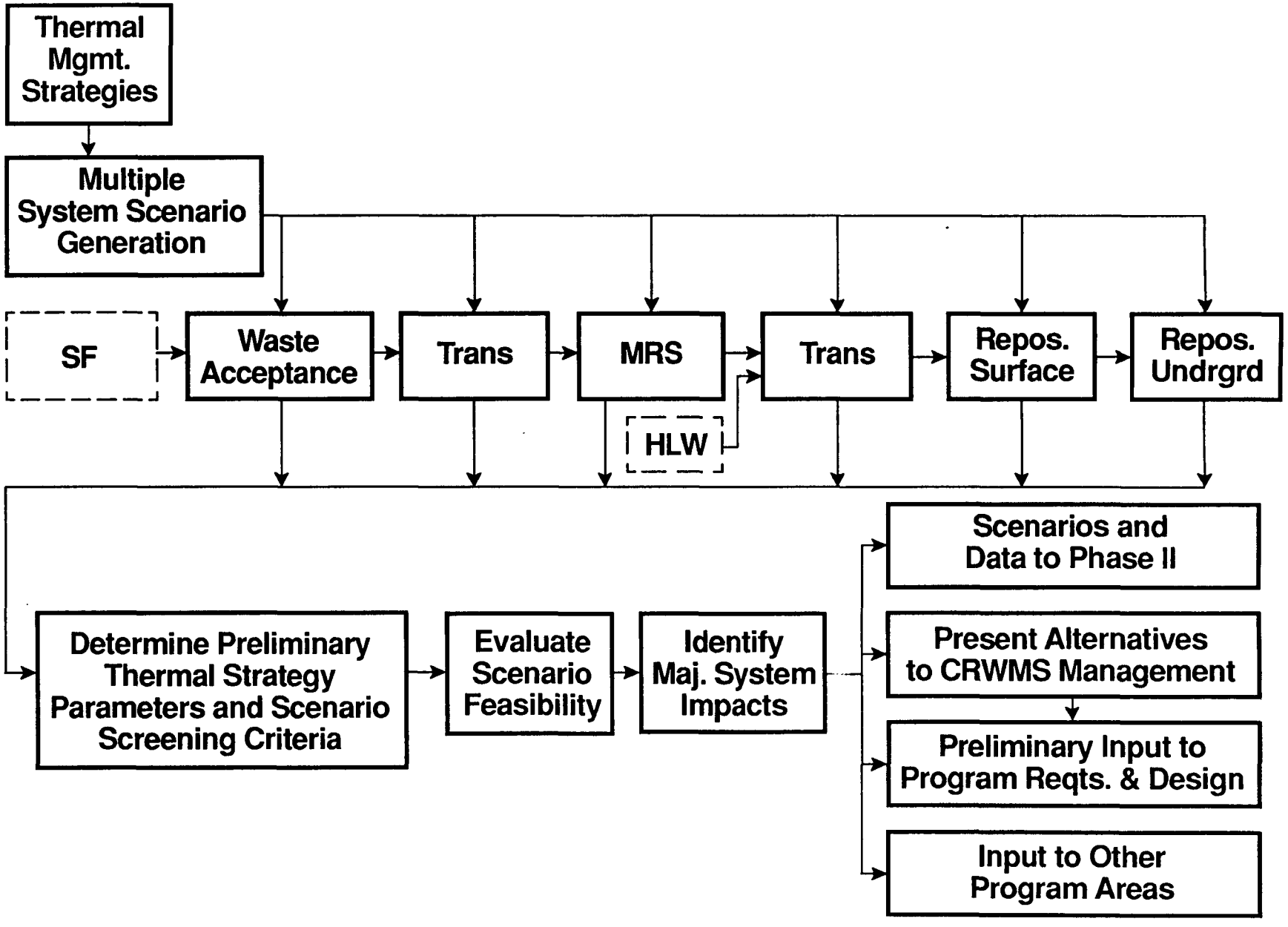
- Establish four thermal-management strategies (expected to be physically achievable):
  - Long-term hot (above boiling for at least 10,000 years)
  - Intermediate-term hot (above boiling for at least 1,000 years)
  - Similar to SCP (57 kW/acre, 30 year average SF age)
  - Cold (below boiling throughout the repository)
- Define analysis methodology and scenario feasibility screening criteria
  - Emplacement parameters (Areal Power Density, etc.) which support thermal strategies
  - Emplacement operations concepts supported by analogous existing technology
  - Waste acceptance consistent with available SF

Phase I Study Approach

(CONTINUED)

- Generate candidate system scenarios, including the following elements:
  - Emplacement methodology, sequencing, scheduling, movability
  - Waste acceptance strategy
  - MRS pass-through vs selective withdrawal from inventory
  - SF blending at MRS or MGDS
  - Extended storage
- Evaluate system scenarios
  - Test feasibility of each generated scenario
  - Modify rejected scenarios (as appropriate)
  - Define a set of feasible scenarios
- Identify and evaluate major impacts on system and system components
- Present results to decision-makers

Phase I Analysis Approach



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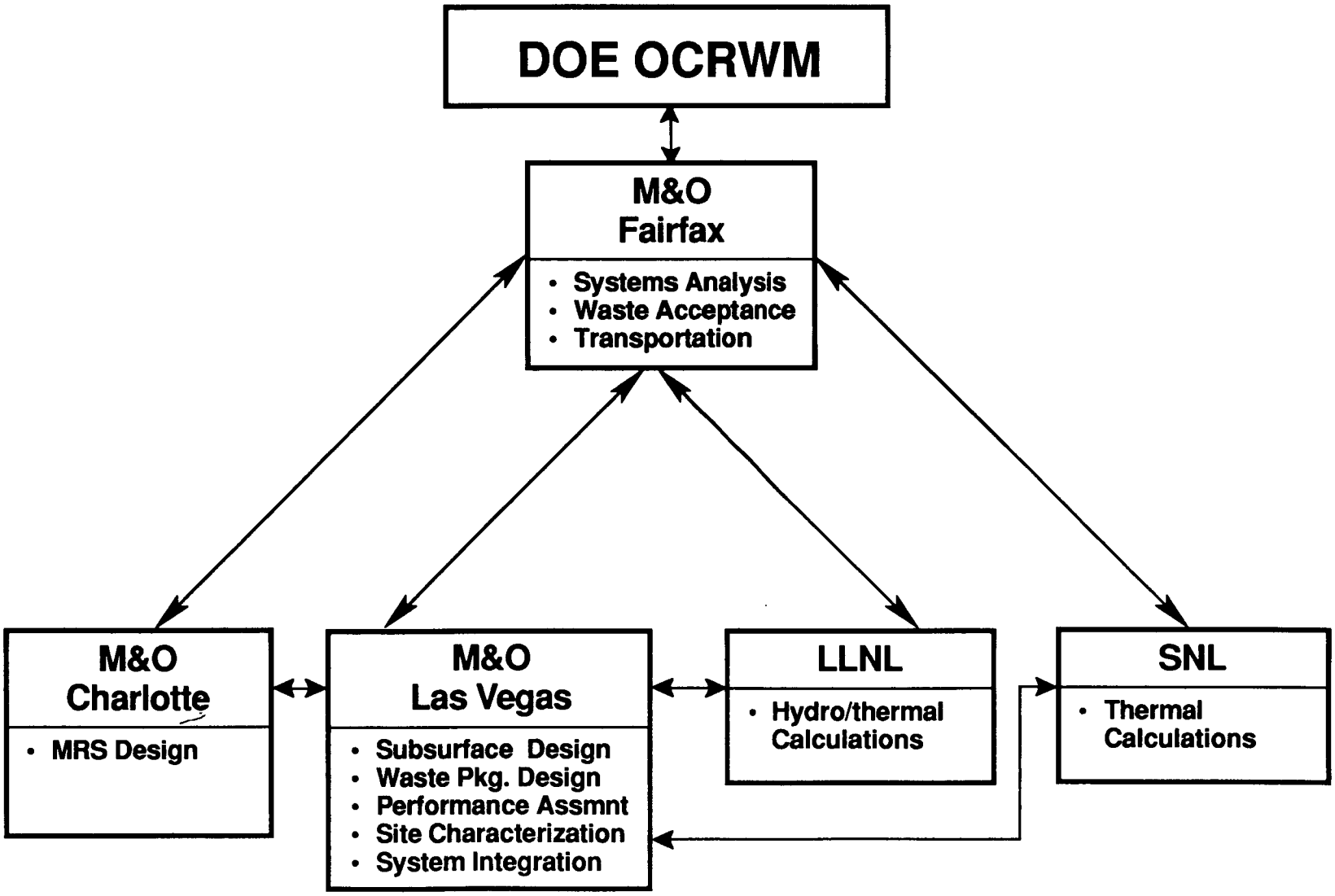
Communication Among Principal Study Participants



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Potential Major System Issues

- Potential SF selection according to fuel characteristics, rather than to allocation rights

- Potential MRS requirements
  - Fuel blending (according to age and burnup)
  - Selective withdrawal from long- or short-term inventory
  - Consolidation
  - Extended storage duration (for cold strategy and, possibly, for long-term hot)
  - Storage capacity

Potential Major System Issues

(CONTINUED)

- Potential MGDS requirements
  - Emplacement sequence and/or relocation
  - Lag storage to accommodate blending and/or selective emplacement
  - Spacing requirements
  - Climate control (e.g. ventilation)
  - Roof stability
  - Retrievability
- Other potential system impact issues
  - Disposition of retrieved waste (if necessary)
  - Use of dual-purpose and/or universal casks

Phase I
Assumptions for Initial Scenario Generation

- Schedule/capacity bases to hold throughout the study
  - One repository, which will store 63,000 MTU SF
  - Repository to store HLW in the equivalent of 7,000 MTU
  - First acceptance of SF at MRS in 1998

- Initial constraints on MRS
  - 10,000/15,000 inventory constraint
  - 40 years licensed period
  - No processing

- Most frequently used prior assumptions for the MGDS (which would use previous study data)
  - All waste packaging at MGDS
  - SCP-type waste package with borehole emplacement
  - First emplacement in 2010

Phase I Variations on Initial Assumptions

- MGDS variations
  - Drift emplacement
  - Robust waste package
  - Emplacement sequence and/or relocation
- MRS constraint relaxations
  - Expanded inventory
  - Extended period of operation
  - Selective withdrawal of SF from inventory (storage)
- Waste acceptance variations
  - Levelized acceptance
  - Priority for reactors requiring new dry storage (capital investment)
  - Youngest fuel over N yrs age ($N \geq 5$)

Phase I Study Output

- A set of system scenarios consistent with
  - Initial feasibility requirements
  - Thermal management strategies
- Provide interim impact data to support host siting negotiations
- Information to support program requirements, design activities, and other needs
  - MRS system specification
  - Transportation cask procurements
  - Licensing
- Plan for Phase II of the study
  - Reviewed by all program participants
  - Scheduled to meet specific program milestones for MRS and MGDS
- Inputs for Phase II of the study

Phase II Study Approach

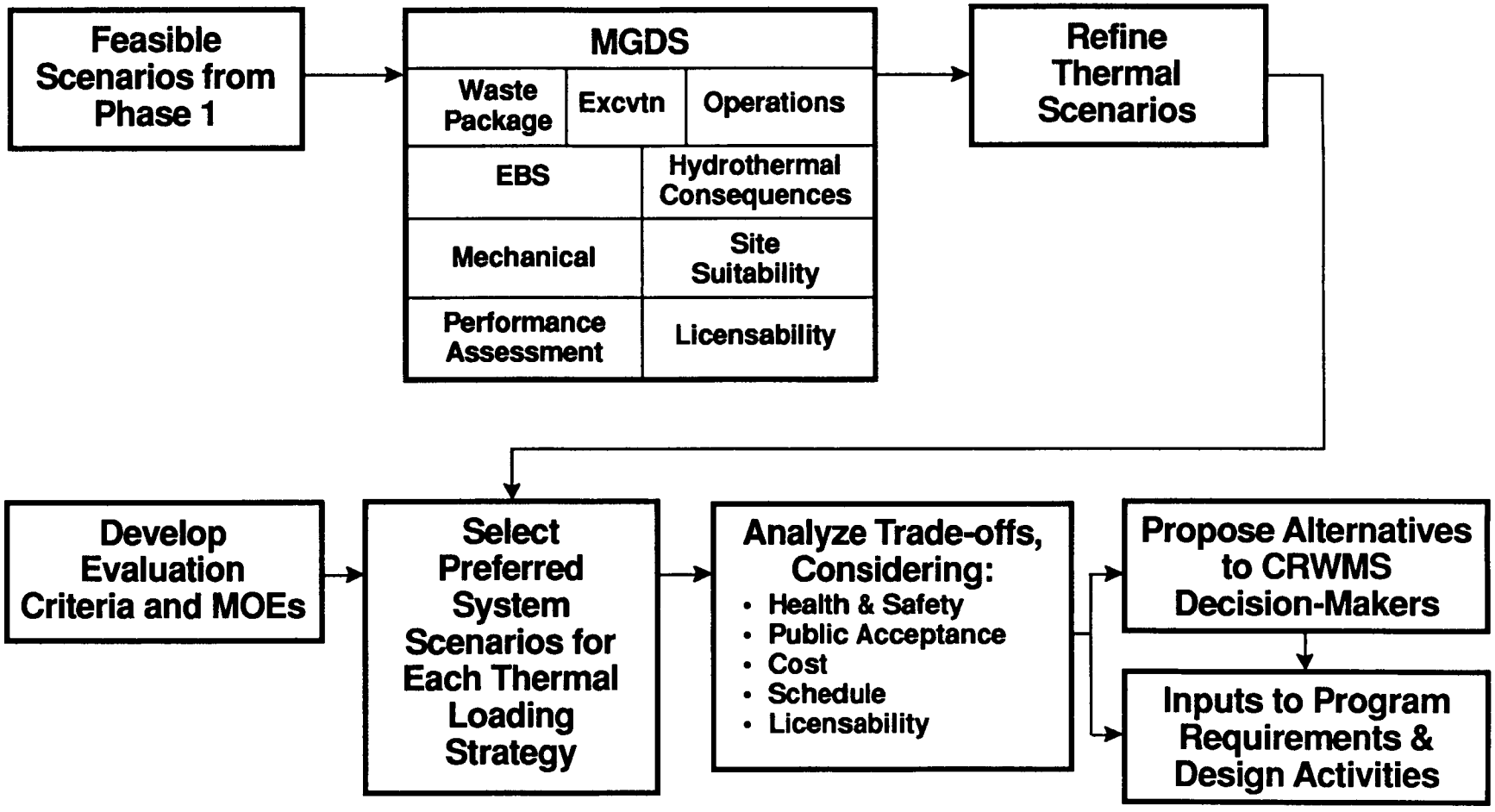
- Use performance assessment and licensability focus to refine thermal strategies
  - Incorporate new performance assessment and licensing studies
  - Refine relation between emplacement parameters and hydro/thermal/mech behavior
- Refine MGDS scenarios to support refined emplacement parameters
  - Waste package
  - Operations (excavation and emplacement)
- Refine waste movement scenarios to support the refined emplacement parameters and MGDS scenarios
- Assess impacts on site characterization requirements

Phase II Study Approach

(CONTINUED)

- Establish total system evaluation criteria and measures of effectiveness
  - Total system costs
  - Operational complexity
  - Schedule (and duration of aboveground storage)
- Incorporate measures of external impacts
  - Public acceptance
  - Health and safety
- Propose alternative strategy/scenario options reflecting refined evaluations, including risk

Analysis
Phase II Study Approach



Final Study Output: Phase II

- Preferred implementation scenario for each thermal management strategy
- Comparison of thermal management strategies, taking into consideration
  - Health and safety
  - Public acceptance
  - Cost
  - Schedule
  - Licensability
  - Site suitability

Final Study Output: Phase II

(CONTINUED)

- Inputs to program requirements and design activities
  - System steady-state throughput rates
  - Annual SF receipt rates to MRS
  - Annual SF shipping rates from MRS
  - Annual SF receipt rates at MGDS
  - Annual HLW receipt rates at MGDS

- Proposed alternatives to program decision-makers, with supporting evaluations,
  - Identifying remaining unknowns and their ranges of uncertainty

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EDUCATION: BS Physics, Cal-Tech
PhD Physics, MIT

EXPERIENCE:

10 YEARS WITH TRW: Systems analysis of instrument selection for NASA Earth Observing System Spacecraft, with particular consideration of system requirements for pointing accuracy of instruments to perform simultaneous observations from different platforms. Responsible for developing software to support integration and test of major software development projects; major accomplishment: developing software to support the test program for the image information processing system for the NASA Space Telescope program. Responsible for systems analysis of problems relating to hardware and software logistics; major accomplishment: analysis of fault-isolation problems in the MX guidance computer.

8 YEARS WITH DAMES & MOORE: Director of Quality Assurance, responsible for developing and implementing 10CFR60 QA program for consulting services (particularly geotechnical investigations) for nuclear power plant siting and development. Manager of risk analysis for site evaluation studies, particularly nuclear power plants. Major accomplishments as follows: managing the development of an inventory of the Western United States for geographic and demographic information for siting a nuclear energy center, and the decision algorithms for processing that data for site evaluation for the Western Nuclear Interstate Board.

8 YEARS WITH SPL: Engineering group supervisor, responsible for spacecraft system design, spacecraft telemetry tracking analysis, and image processing. Major accomplishments include: (1) development of area-scan picture coding scheme for a detector noise limited surveillance system; (2) lunar gravity modeling based on Lunar orbiter and Apollo tracking data; and (3) image analysis of Lunar orbiter pictures to identify features correlated with gravity anomalies.

TEACHING (15 years part-time): Director of Master's degree program in systems engineering at West Coast University, Los Angeles.

PUBLICATIONS: Over 20 papers published in the refereed literature, textbook, "Probability and Statistics," published by Addison-Wesley 1971.