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

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: ROLE OF ANALOGUES IN THE RADIONUCLIDE TRANSPORT PROGRAM

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ROLE OF ANALOGUES IN THE RADIONUCLIDE TRANSPORT PROGRAM

SEEK THE USE OF NATURAL ANALOGUES TO VALIDATE

- OUR UNDERSTANDING OF RADIONUCLIDE TRANSPORT PROCESSES (i.e., RADIONUCLIDE SOLUBILITY, SORPTION, DIFFUSION, DISPERSION)

- CONCEPTUAL MODELS (DEVELOPMENT AND TESTING) FOR RADIONUCLIDE TRANSPORT AT YUCCA MOUNTAIN

ROLE OF ANALOGUES IN THE RADIONUCLIDE TRANSPORT PROGRAM

(CONTINUED)

SEEK THE USE OF NATURAL ANALOGUES TO VALIDATE

- COMPUTATIONAL CODES (CONSTRUCTION AND TESTING) THAT MODEL RADIONUCLIDE TRANSPORT BY TESTING CODE PREDICTIVE CAPABILITY

- APPLICATION OF PERFORMANCE MODELING TO LONG-TERM TRANSPORT PROCESSES

ROLE OF ANALOGUES

(CONTINUED)

ANALOGUES MAY PROVIDE NEEDED INFORMATION - A PIECE OF THE PUZZLE OR KEY PARAMETERS THAT CANNOT BE OBTAINED THROUGH LABORATORY OR CONTROLLED FIELD TESTS

- TRANSPORT PROCESSES
- TIME-SCALE
- SIZE-SCALE

ROLE OF ANALOGUES

(CONTINUED)

ANALOGUES MAY PROVIDE EVIDENCE THAT WE UNDERSTAND RADIONUCLIDE TRANSPORT

- DEFINES SITUATIONS WHERE MODELS OR CONCEPTS CAN BE APPLIED
- VALIDATE ASSUMPTIONS
- MAY NOT BE SEEN AS SELECTIVE EVIDENCE, BUT STRENGTHENS CREDIBILITY

REFERENCE: INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) (1989)
TECHNICAL REPORT SERIES #304

ROLE OF ANALOGUES

(CONTINUED)

SITE CHARACTERIZATION PLAN DISCUSSION OF NATURAL ANALOGUES

CHAPTER 4, pp. 4-129 THROUGH 4-142

- WARM AND HOT SPRINGS
- OKLO
- ALLIGATOR RIVERS
- NTS, CAMBRIC SITE
- PAJARITO PLATEAU, LOS ALAMOS, TA-21, AREA T (PU PROCESSED WASTE DISPOSAL SITE)

ROLE OF ANALOGUES

(CONTINUED)

SITE CHARACTERIZATION PLAN STUDIES ON ANALOGUES SUPPORTING RADIONUCLIDE MIGRATION

CHAPTER 8

8.3.1.3.3.1 AND 8.3.1.3.2.2	MINERAL ALTERATION AND WATER CHEMISTRY ANALGUES
8.3.1.2.2.2, 8.3.1.2.2.7 and 8.3.1.2.3.2	TRACER MIGRATION ANALOGUE: Cl-36, Tc-99, NOBLE GASES, C-14, TRITIUM

ROLE OF ANALOGUES

(CONTINUED)

RADIONUCLIDE MIGRATION PROGRAM VALIDATION AT LOS ALAMOS

LABORATORY VALIDATION TESTS FOR RADIONUCLIDE TRANSPORT

8.3.1.3.6.1	LABORATORY COLUMN EXPERIMENTS
8.3.1.3.6.1 and AECL	LARGE BLOCK EXPERIMENTS

FIELD VALIDATION TESTS - 8.3.1.3.7.2

- CONTROLLED FIELD TEST
- NATURAL ANALOGUES
- ANTHROPOGENIC ANALOGUES

ROLE OF ANALOGUES

(CONTINUED)

TYPES OF NATURAL ANALOGUES FOR RADIONUCLIDE TRANSPORT VALIDATION

- MINERAL ALTERATION AND WATER CHEMISTRY (YELLOWSTONE, NEW ZEALAND GEOTHERMAL SYSTEM, YUCCA MOUNTAIN)
- SOLUBILITY AND SPECIATION OF RADIONUCLIDES [URANIUM DEPOSITS, MILL TAILINGS, CAMBRIC TEST AT NEVADA TEST SITE, PAJARITO PLATEAU (TA-21)]
- RADIONUCLIDE SORPTION [C-14 IN TUFF AQUIFER, URANIUM DEPOSITS (CLAY), CAMBRIC TEST AT NTS, PAJARITO PLATEAU (TA-21)]
- MATRIX DIFFUSION: URANIUM DEPOSITS, CHLORINE IN TUFF INVADED BY SEA WATER

ROLE OF ANALOGUES

(CONTINUED)

- FRACTURE TRANSPORT [YUCCA MOUNTAIN, RAINIER MESA, APACHE LEAP, PAJARITO PLATEAU (Cl-36, Tc-99, TRITIUM, NOBLE GASES)]
- COLLOID TRANSPORT [NTS-CHESHIRE, URANIUM DEPOSITS, PAJARITO PLATEAU (TA-21)]
- ANALOGUE SITES (NATURAL) FOR RADIONUCLIDE MIGRATION IN TUFF
  - PAJARITO PLATEAU - BANDELIER TUFF, LOS ALAMOS, NEW MEXICO
  - RAINIER MESA - NEVADA
  - URANIUM DEPOSITS IN TUFF - THROUGHOUT NEVADA
- ANALOGUE SITES FOR RADIONUCLIDE MIGRATION IN NONTUFF (OKLO, POÇOS de CALDAS, ALLIGATOR RIVERS, CIGAR LAKE)

ROLE OF ANALOGUES

(CONTINUED)

TYPES OF ANTHROPOGENIC ANALOGUES

- RADIONUCLIDE MIGRATION AT NTS (SIMILAR GEOMEDIA TO YUCCA MOUNTAIN) - HYDROLOGY/RADIONUCLIDE PROJECT, DOE/NV
- RADIONUCLIDE MIGRATION AT LOS ALAMOS AREA T (TA-21) ON THE PAJARITO PLATEAU IN BANDELIER TUFF (OUTFALL FROM Pu PROCESSING, 1948-1958)
- RAINIER MESA, NEVADA
- HANFORD, WASHINGTON (NONTUFF)
- IDAHO NATIONAL ENGINEERING LABORATORY (NONTUFF)

ROLE OF ANALOGUES

(CONTINUED)

CONCERNS:

- CLEAR OBJECTIVES
- CAREFUL CONSIDERATION OF ALLOCATION OF RESOURCES
- VALIDATION IN THE STRICTEST SENSE MUST BE DONE WITHIN A QUALITY ASSURANCE PROGRAM

ROLE OF ANALOGUES

(CONTINUED)

CLEAR OBJECTIVES FOR STUDYING ANALOGUE SYSTEM MUST BE REQUIRED

- VALIDATE A PROCESS OR ASSUMPTIONS
- ANALOGUE SYSTEM MUST ADDRESS AN ELEMENT OF THE YUCCA MOUNTAIN SYSTEM THAT AFFECTS PERFORMANCE (e.g., TRANSPORT BY FRACTURE FLOW)

ROLE OF ANALOGUES

(CONTINUED)

CAREFUL CONSIDERATION TO ALLOCATION OF RESOURCES

- ANALOGUE INITIAL CONDITIONS ARE DIFFICULT TO DEFINE
- DIFFICULT TO DECOUPLE PROCESSES THAT HAVE OCCURRED

THEREFORE: FUNDS CAN BE EXHAUSTED SOLVING TECHNICAL QUESTIONS IN AN ANALOGUE SYSTEM RATHER THAN FOR THE YUCCA MOUNTAIN SYSTEM

ROLE OF ANALOGUES

(CONTINUED)

VALIDATION IN THE STRICTEST SENSE MUST BE DONE WITHIN A QUALITY ASSURANCE PROGRAM

QUANTITATIVE USE OF ANALOGUES

- EASILY DONE FOR STUDIES THAT ARE CONDUCTED UNDER THE AUSPICES OF YMP AND SUBJECTED TO THE RIGOR OF THE QUALITY ASSURANCE PROGRAM
- NO GUARANTEE FOR PROGRAMS OUTSIDE YMP
- QUALIFICATION OF SUCH DATA MAY NOT BE COST EFFECTIVE

QUALITATIVE USE OF ANALOGUES

- QUALITY PROGRAM MAY NOT NEED TO APPLY

THESE ARE MANAGEMENT CHOICES

ROLE OF ANALOGUES

(CONTINUED)

CURRENT STATUS - MANAGEMENT PERSPECTIVE ON THE LOS ALAMOS SCIENTIFIC CONTRIBUTIONS

- RESPONSIBILITY TO PROVIDE THE BEST DATA AND BEST POSSIBLE UNDERSTANDING OF RADIONUCLIDE TRANSPORT AT YUCCA MOUNTAIN SO THAT DOE MAY ASSESS THE POTENTIAL FOR RADIONUCLIDE TRANSPORT AT YUCCA MOUNTAIN

- DATA MUST BE OBTAINED UNDER AN ACCEPTABLE QUALITY ASSURANCE PROGRAM. PROCESSES AND MODELS MUST BE VALIDATED AS PART OF THAT PROGRAM