COMMENTS OF THE SEISMIC HAZARD AT YUCCA MOUNTAIN

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THE STATE OF NEVADA HAS COMMENTED EXTENSIVELY TO THIS BOARD ABOUT A SEISMIC HAZARD ASSESSMENT OF YUCCA MOUNTAIN. IN ADDITION, THE STATE CONTINUES TO QUESTION THE ADEQUACY AND EFFICACY OF DOE'S STUDY PLANS FOR EVALUATING SEISMIC HAZARDS. MY REMARKS TODAY WILL NOT REPEAT THOSE COMMENTS SINCE THEY ARE ALREADY PART OF THE PUBLIC RECORD, BUT WILL FOCUS MY COMMENTS ON HAZARD VERSUS RISK, AND WHAT WE KNOW AND DON'T KNOW ABOUT THE POTENTIAL HAZARDS OF THE YUCCA MOUNTAIN NATURAL SYSTEM AND THE ENGINEERED SYSTEM.

THERE IS A NEED TO MAKE A CLEAR DISTINCTION BETWEEN HAZARDS ASSESSMENT AND RISK ASSESSMENT. THE SITE CHARACTERIZATION PROGRAM IS SUPPOSED TO DEVELOP THE INFORMATION NECESSARY TO DO A HAZARDS ASSESSMENT OF THE SITE SANS ENGINEERED SYSTEMS. THIS IS WORK IN PROGRESS AND THERE IS A LONG WAY TO GO. AT SOME POINT WHEN SUFFICIENT INFORMATION IS DEVELOPED TO PROVIDE REASONABLE ASSURANCES THAT THE SITE WILL BE ABLE TO MEET ALL REGULATORY CRITERIA (10CFR60, & 40CFR191), WITHOUT NEED TO RESORT TO ANY UNTESTED ENGINEERING SOLUTIONS, THE DESIGN PROCESS CAN BEGIN IN EARNEST.

HAZARDS DESCRIBES THE POTENTIAL FOR NATURAL RELATED PHENOMENA TO OCCUR (E.G., VIBRATORY GROUND MOTION FROM NEAR FIELD SOURCES, FAULT RUPTURE, FRACTURING, VOLCANIC ACTIVITY, INTRUSIONS, GROUND WATER RISE, GEOCHEMICAL PROCESSES, ETC.). IT IS STRICTLY A SPATIAL MEASURE. OCCURRENCE OF THESE PHENOMENA EITHER SINGULARLY OR AS COUPLED PROCESSES COULD RESULT IN ADVERSE CONSEQUENCES (E.G. CAUSE THE UNCONTROLLED RELEASE OF RADIONUCLIDES TO THE ACCESSIBLE ENVIRONMENT). TO SATISFY THE SITING REQUIREMENTS, WE NEED TO FIRST KNOW THE NATURAL SYSTEMS AND ALL OF THE POTENTIAL OPERATIVE PROCESSES IN ORDER TO DEFINE THE HAZARD. SUBSEQUENT TO THE HAZARD DEFINITION, WE CAN START TO CONCEPTUALIZE WHAT THE ENGINEERED SYSTEM NEEDS TO BE AND THE WAY(S) IT CAN FAIL WHEN SUBJECT TO THE HAZARDS IN ORDER TO ESTABLISH THE POTENTIAL CONSEQUENCES. ONCE A CONCEPTUAL DESIGN HAS BEEN DECIDED UPON THAT MINIMIZES THE POTENTIAL CONSEQUENCES, A RISK ASSESSMENT CAN BE MADE.

RISK IS THE PROBABILISTIC EXPRESSION OF THE PRODUCT OF THE HAZARDS AND ITS CONSEQUENCES. THE LEVEL OF RISK THAT WILL BE ACCEPTABLE WILL ULTIMATELY BE DETERMINED BY THE GOVERNMENT AND CITIZENS OF THE STATE OF NEVADA. TO REDUCE THE RISK OF AN ACCEPTABLE LEVEL (WHATEVER THAT TURNS OUT TO BE) WILL REQUIRE EITHER REDUCING THE UNCERTAINTIES IN OUR KNOWLEDGE OF THE NATURAL SYSTEM AND HOW IT OPERATES AND/OR CHANGING THE FRAGILITY OF THE ENGINEERED SYSTEM SO THAT IT IS LESS VULNERABLE TO BEING AFFECTED BY NATURAL PHENOMENA.

WE CAN NOT ENGINEER THE NATURAL SYSTEM. WE CAN ONLY STRIVE TO UNDERSTAND THAT SYSTEM TO THE POINT WHERE WE WILL BE "REASONABLY ASSURED" THAT WE KNOW WHAT ALL OF THE SIGNIFICANT OPERATIVE PROCESSES ARE; HOW THESE PROCESSES ARE SPATIALLY DISTRIBUTED; WHETHER THESE PROCESSES OPERATE SEPARATELY OR ARE COUPLED; AND HOW THESE PROCESSES MIGHT CHANGE IN TIME WHEN THE ENGINEERED SYSTEM IS DISTURBED BY THE OCCURRENCE OF ANY OF THE NATURAL PHENOMENA. ONCE THE NATURAL SYSTEM IS DETERMINISTICALLY DEFINED WITH "REASONABLE ASSURANCE," THEN AND ONLY THEN CAN WE BEGIN TO DECIDE WHETHER AN ENGINEERED SYSTEM CAN BE DESIGNED, LICENSED, AND CONSTRUCTED THAT WILL MEET THE PUBLIC'S REQUIREMENTS FOR ACCEPTABLE RISK.

WHAT DO WE KNOW ABOUT THE POTENTIAL HAZARDS OF THE YUCCA MOUNTAIN NATURAL SYSTEM?

- WE KNOW THAT THERE ARE SOME VERY ACTIVE FAULTS (BY ANY STANDARD) OPERATING IN THE GEOLOGIC SETTING THAT INCLUDES YUCCA MOUNTAIN.
- WE KNOW THAT THERE ARE FAULTS CUTTING THROUGH AND BOUNDING THE PROPOSED REPOSITORY BLOCK THAT CAN PROVIDE DIRECT FRACTURE PATHWAYS TO THE ACCESSIBLE ENVIRONMENT.
- WE KNOW THAT FRACTURING ON THE SURFACE IN THE PROPOSED REPOSITORY BLOCK IS PERVASIVE.
- WE KNOW THAT THERE ARE ACTIVE VOLCANIC PROCESSES OPERATING WITHIN THE YUCCA MOUNTAIN GEOLOGIC SETTING.
- WE KNOW THAT THERE HAVE BEEN VOLCANIC PROCESSES THAT HAVE DIRECTLY AFFECTED YUCCA MOUNTAIN IN THE PAST.

- WE KNOW THAT THERE HAS BEEN A COUPLING OF VOLCANIC PROCESSES AND SEISMOGENIC PROCESSES IN THE PAST.
- WE KNOW THAT THERE HAS BEEN HYDROTHERMAL ALTERATION OF THE ROCKS IN YUCCA MOUNTAIN.

WHAT WE DON'T KNOW ABOUT THE NATURAL SYSTEM OF YUCCA MOUNTAIN IS:

- THE TYPE, LOCATION AND EXTENT OF ACTIVE BLIND FAULTS UNDER AND AROUND YUCCA MOUNTAIN.
- THE DISTRIBUTION OF FRACTURES WITHIN YUCCA MOUNTAIN.
- HOW THE FRACTURE PERMEABILITY WILL CHANGE DUE TO EARTHQUAKES ON ANY OF THE BLIND FAULTS.
- HOW THE GROUNDWATER SYSTEMS WILL CHANGE IN RESPONSE TO MOVEMENT ON ANY OF THE FAULTS.
- THE STRUCTURAL CONTROL FOR VOLCANIC PROCESSES IN THE VICINITY OF YUCCA MOUNTAIN.
- WHETHER THERE IS AN ACTIVE MAGMA CHAMBER IN THE VICINITY OF YUCCA MOUNTAIN.
- HOW FLUIDS MOVE THROUGH THE VADOSE ZONE.

WHAT DO WE KNOW ABOUT THE ENGINEERED SYSTEMS?

- NOTHING.

WE, THEREFORE, HAVE NO IDEA WHAT THE POTENTIAL CONSEQUENCES COULD BE IN RESPONSE TO SOME NATURAL PHENOMENA OCCURRING. WE ALSO CAN'T BE SURE THAT ANY HAZARDS ASSESSMENT RESULTS BEING PRODUCED BY THE

PRESENT ONGOING PROCESSES ARE RELEVANT TO NEEDS OF DESIGN ENGINEERS.

WHAT WE <u>DON'T KNOW</u> ABOUT THE ENGINEERED SYSTEMS:

- HOW MUCH AND WHAT KIND OF WASTE THERE WILL BE. IS IT 77,000 MT; 86,000 MT; 100,000 MT? HOW MUCH OF IT IS DEFENSE WASTE OR IS THAT IN ADDITION TO THE 86,000 MT? WHAT OTHER TYPES OF NON-SPENT FUEL WASTE IS BEING CONSIDERED? IS THE PLUTONIUM FROM THE WEAPONS DISASSEMBLY BEING CONSIDERED FOR DISPOSAL AS HIGH-LEVEL WASTE?
- WHAT THE THERMAL LOADING STRATEGY WILL BE. HOW CAN THE THERMAL LOADING STRATEGY BE FINALIZED IF ALL OF THE WASTE STREAMS THAT WOULD GO INTO THE SYSTEM ARE UNKNOWN?
- HOW PERVASIVE THE FAULTING AND FRACTURING IS AT REPOSITORY LEVEL.
- HOW MUCH SPACE WILL BE AVAILABLE IF ANY FAULT SETBACK CRITERIA IS FOLLOWED.
- HOW TO DETERMINE NEAR FIELD SEISMIC GROUND MOTION FROM AS YET TO BE IDENTIFIED SOURCES.
- HOW TO EFFECTIVELY TRANSLATE NEAR FIELD SEISMIC GROUND MOTION INTO REPOSITORY DESIGN.
- HOW TO TEST A NEAR FIELD SEISMIC DESIGN.
- HOW TO DESIGN AND TEST SEALS TO WITHSTAND VIBRATORY GROUND MOTION - BOTH FAR FIELD AND NEAR FIELD.
- WHAT THE POTENTIAL CONSEQUENCES OF SYSTEM FAILURE ARE.

I CLOSE MY REMARKS WITH A QUOTE FROM A BEST-SELLING AUTHOR WHO IS IN THE ROOM, LEON REITER.

"THE (SEISMIC) ANALYSIS NEEDED TO HELP PREVENT THE PUBLIC FROM BEING SUBJECTED TO AN UNEXPECTED RELEASE OF RADIOACTIVE WASTE FROM AN UNDERGROUND REPOSITORY DURING ITS 10,000+ YEARS LIFETIME IS QUITE DIFFERENT FROM THE SEISMIC ANALYSIS NEEDED TO HELP PREVENT EARTHQUAKE-INDUCED DEATHS AND SERIOUS INJURY DURING THE 40-50 YR. LIFE OF A NUCLEAR POWER PLANT."

"THE ANALYSIS FOR A REPOSITORY MUST TAKE INTO ACCOUNT GREAT PUBLIC SCRUTINY, HYPOTHETICAL CHANGES IN THE TECTONIC REGIME DURING THE NEXT 10,000 YRS., AND THE EFFECTS OF EARTHQUAKES ON BURIED WASTE CONTAINERS AND GROUND WATER FLOW, THE PATH OF RADIONUCLIDE RELEASE TO THE ENVIRONMENT."