



Update on State of Nevada Technical Activities Related to Yucca Mountain

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Nuclear Waste Technical Review Board
Las Vegas Spring Meeting
June 11, 2009



Nevada technical activities

- Will concentrate on Nevada activities related to
 - Main post-closure technical issues
 - Cross-cutting programmatic safety and legal issues (Marty Malsch)
- There have been important changes since last NWTRB meeting
- May 11 the NRC Licensing Boards accepted for hearing nearly all of Nevada's over 200 "contentions," most of them safety issues
 - The contentions are the result of Nevada's long technical preparation, some of which I will describe
 - The Boards' action is important in validating the issues, especially as DOE opposed every single one, and NRC Staff all but a few
- May 20 the President released his 2010 DOE budget, which states, "*The Administration proposes to eliminate the Yucca Mountain repository program.*" This is, so to speak, the writing on the wall
 - There are funds for DOE "*participation in the repository license proceeding before the NRC,*" so Nevada has to remain engaged
 - Despite its earlier rejection of all safety issues for hearing, DOE did not now appeal the NRC Boards' May 11 ruling



Nevada decided early on technical case

- Nevada decided from the start that it would take on DOE's technical case in detail, especially the post-closure case based on the formidable Total System Performance Assessment computer simulation
- Starting in 2002, Nevada engaged about 20 experts in all the key scientific and technical areas of the TSPA
- Nevada also supported some original scientific work, most notably corrosion experiments that simulated dripping on waste package materials in drifts
- Overall Technical Coordinator: Mike Thorne, a specialist in performance assessment, advisor to UK and European regulatory agencies and waste management organizations, and Fellow, Society for Radiological Protection. The US coordinator: Allen Messenger, 30 years experience in environmental engineering, soil and groundwater contamination, and radioactive waste management



Nevada corrosion experiments

- Early on Nevada recognized waste package corrosion as a key area, perhaps *the* key area, and supported experiments at Catholic University
- Followed up with more realistic experiments that simulated *dripping* at the Institute of Metals Research of the Chinese Academy of Science, one of the premier such laboratories in the world
- Results of IMR Reports (2008)
 - In a system that models dripping on very hot waste packages in hot drifts, localized corrosion occurred beneath the accumulating deposit which sequesters aggressive acids
 - Corrosion rates suggest waste package penetration in *10s to 100s* of years
 - (This is not so different from what DOE assumes in its Early Drip Shield Failure Case, relying on literature data, apparently in view of the flaws in its own work)
- More recently, Nevada has been following the NRC review closely, and wrote to the Staff (April 2009) about DOE's response to an NRC "Request for Additional Information":
 - *NRC should not allow DOE to rely on immersion experiments to cover the dripping case, as DOE insisted was acceptable (DOE dismissed its own dripping experiments)*
 - *NRC should require DOE to provide dose calculations for the case where drip shields fail or are entirely absent, as DOE relies overwhelmingly on drip shields to provide corrosion protection*

Nevada got capability to run TSPA model

- Nevada also decided early to get capability to independently run the enormously complicated GoldSim-based TSPA computer simulation--so as not to be at the mercy of DOE's "black box"
- The State of Nevada maintains a GoldSim License for use on TSPA program (held by Mike Thorne and Associates, Ltd, UK)
- Mike's UK Team applies to the TSPA application its long experience with GoldSim in other applications, such as safety assessments for the UK Nuclear Decommissioning Authority
- The UK Team studied the TSPA-LA and performed individual runs
 - Nevada cannot realistically duplicate DOE calculations of dose averages, which require hundreds of runs per case, but can check individual DOE's calculations
 - The UK Team's familiarity with the TSPA model contributed to Nevada's development of contentions
- One apparent benefit already: NRC decided also to get the same capability (which it earlier had not planned to do)

Selected experts (total # safety cont's)

Climate	J Overpeck, Professor, Atmospheric Sciences, U of Arizona (7)	
Precipitation	HS Wheater, Professor of Hydrology, Imperial College, London (29)	RE Chandler, Senior Lecturer in Statistics, University College London (15)
Infiltration	AP Butler, Reader, Subsurface Hydrology, Imperial College (22)	RE Chandler, HS Wheater
Unsaturated zone flow	SK Matthai, Professor of Reservoir Engineering, U of Leoben, Austria (18)	AP Butler, HS Wheater
Geochemistry of near field and seepage	AH Bath, Advisor to UK, Swiss, Swed., Finnish nuclear regulators (19) ME Morgenstein, President, Geosciences Management Inst. (50)	DL Shettel, Jr., Adjunct Prof of Geology, College of Southern Nevada (32)
Drip shield and waste package corrosion	RA Cottis, Reader, Corrosion Science and Engineering, Manchester Institute of Science and Technology (39)	ME Morgenstein BJ Little, Senior Scientist for Marine Molecular Processes, Naval Research Laboratory, Stennis Space Center (3)
Waste form dissolution	ME Morgenstein	
Lower unsat. zone transp.	AH Bath	
Saturated zone transport	AH Bath	
Biosphere dose	MC Thorne (61, in all areas)	
Volcanic issues	EI Smith, Prof. of Geology, UNLV (9)	
Repository constr.& op's, rock mechanics	DF Hambley, PE, Agapito Associates, Mining specialist (Kendorski's firm) (30) S Frishman, Consultant, Geologist (17)	J A McMaster, MC Consulting, Titanium alloys (18) A Messenger (6)



TSPA Areas (# of contentions in area)

Climate model (4); precipitation (6)

Infiltration into Yucca Mountain (22)

Flow down Unsaturated Zone (13)

Geochemistry and seepage into drifts (22)

Corrosion of drip shield and waste package (34)

Dissolution of spent fuel (2)

Radionuclide transport to Sat. Zone (3)

Other on
rep. design,
op's & post
closure (64)

Transport in Sat. Zone to Biosphere (2)

Biosphere dose to Reasonably
Maximally Exposed Individual (3)

Cross-cutting TSPA concerns

- Nevada believes that DOE's Yucca Mountain TSPA calculations underestimate water flow, waste package corrosion, and amounts of radionuclides arriving at the measuring point, and therefore underestimate the dose to RMEI
- Criticisms which come up repeatedly in Nevada's contentions:
 - Reliance on inadequate models for individual processes, and improperly qualified models
 - Underestimates of uncertainty in individual models
 - Failure to evaluate performance with alternative models (which are needed for cross checks because all the models are necessarily crude representations of reality)
 - Insufficient data, or improper use of data
 - Choice of inadequately supported parameter probability distributions
 - Reliance on average flows when more realistic episodic flows would produce markedly different results



Drip shields a special concern

- The drip shields are supposed to keep packages dry; *the catch is, DOE plans to put them in 100 years later*
- Nevada considers it unreasonable to base an LA decision on the assumption this will be done. It may not even be possible in view of drift and infrastructure deterioration. (Recall F. Kendorski NWTRB briefing)
- DOE has no design for remote underground drip shield installation in challenging environment, nor plans to prototype installation
- Still, DOE does not even consider the possibility drip shields won't be installed, and *claims it never did any calculations for this case. NRC Staff has not asked for any!*
- Nevada used DOE's Early Drip Shield Failure Case to estimate the "no-drip shield case"--the dose exceeds EPA's standard at about 1000 years and grows to about 10 times higher (the elephant in the room)
- NRC Staff have said a YM license could be conditioned with the requirement to later install drip shields; but as a practical matter, such a requirement would be unenforceable, and thus meaningless
- What it comes down to: *DOE is asking for a license now on the promise that someone will install the (hugely expensive) drip shields in 100 years*
- Even *with* a drip shield: there would be no redundancy, no defense-in-depth, totally at odds with NRC's approach to nuclear power safety



Lack of redundancy also at odds with international safety standards

- The US is a party to the *Joint Convention On The Safety Of Spent Fuel Management And On The Safety Of Radioactive Waste Management*--it has the force of law
 - “. . . each Contracting Party shall take the appropriate steps to: . . . provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has **due regard to internationally endorsed criteria and standards**”
- There are such criteria in the form of International Atomic Energy Agency guidelines: *Scientific And Technical Basis For Geological Disposal Of Radioactive Wastes, 2003*:
 - “In different geological environments different safety concepts may be proposed for achieving adequate isolation of wastes . . . however, the leading principle is that long term safety is based on a multi-barrier system. **The aim of the multi-barrier concept is to confine the radionuclides so that the failure of one component does not jeopardize the safety of the containment system as a whole.**”
- Other countries take these seriously--the standards in Finland (the country closest to building a repository) state:
 - “. . . the long-term safety of disposal shall be based on **redundant barriers** so that deficiency in one of the barriers or a predictable geological change does not jeopardize the long-term safety”
- (And, by the way, disposal in an oxidizing environment violates IAEA guidelines, too)
- Altogether, the Yucca design doesn't meet traditional nuclear safety standards.

Programmatic and legal hearing issues

- DOE is unfit as repository licensee because of lack of integrity/safety culture
- Unfit for lack of management competence
- DOE's has historically been unable to implement an adequate Quality Assurance program at Yucca Mountain, despite repeated promises to do so
- Yucca Mountain's design violates NRC's multiple barrier rule because safety depends on a single element of engineered system
- The License Application relies on preliminary design information when it should refer to final designs
- DOE lacks required realistic retrieval plans