

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Nuclear Waste Technical Review Board Meeting (NWTRB) on the DOE Supplemental Science and Performance Analyses (SSPA) and Kickoff Meeting of the Joint Nuclear Energy Agency/International Atomic Energy Agency (NEA/IAEA) International Peer Review of the YM TSPA-SR Project Number 20.01402.571, AI Number 20.01402.571.015

DATE/PLACE: June 20–22, 2001
Las Vegas, Nevada

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PERSONS PRESENT: The NWTRB meeting was attended by approximately 80 people. Bret Leslie, John Bradbury, and David Esh [U.S. Nuclear Regulatory Commission (NRC)] were also present. The meeting of the NEA/IAEA peer review panel was attended by about 30–40 people.

BACKGROUND AND PURPOSE OF TRIP:

The purpose of the trip was to attend the presentation to the Performance Assessment and Repository Panels of the NWTRB of the SSPA. The coincidence of the trip with the kickoff meeting of the NEA/IAEA peer review panel was used to attend this meeting too.

SUMMARY OF PERTINENT POINTS:

Nuclear Waste Technical Review Board Meeting

After introductory remarks by Dan Bullen from the NWTRB, Steve Brocoum and William Boyle (DOE) presented the goals and objectives of the SSPA that was essentially prepared to respond to the four points raised by the NWTRB. These points are: (i) meaningful quantification of uncertainties; (ii) understanding of fundamental corrosion processes; (iii) comparison of base-case and lower temperature repository designs; and (iv) development of multiple lines of evidence. Regarding the thermal operating mode, the main conclusion that later was discussed in more detail is that the system level performance is essentially the same for both thermal modes, although differences were observed at the subsystem level for some models. This presentation was followed by presentations by the staff of the DOE contractor, Bechtel SAIC Company (BSC). The SSPA is presented in two volumes, which are Volume 1 Scientific Basis and Analysis and Volume 2 Performance Analyses. The scope and content of both volumes were discussed in some detail by Rob Howard (BSC) and P. Swift (SNL-BSC) respectively. These presentations were followed by presentations on the unsaturated zone (UZ) and nearfield environment (NFE) thermally driven coupled process, EBS coupled process components, waste package (WP) corrosion process components and uncertainties in corrosion processes, waste form process components, UZ and SZ transport, and finally the introduction of new analyses and models in the TSPA code.

In the WP presentation done by G. Gdowski (LLNL) the most significant change was the introduction of a temperature dependent general corrosion rate for Alloy 22 using a limited set of data generated at the University of Virginia over the temperature range of 80 to 95 °C to obtain an activation energy value of 36 kJ/mole which was combined with the temperature-independent corrosion rate measured in the LTCTF tests at LLNL. Joon H. Lee (SNL-BSC) emphasized in his presentation regarding uncertainties in corrosion models changes introduced in the threshold stress for SCC of Alloy 22, which was increased from 20–30 percent to 80–90 percent of the yield strength, based mainly in tests conducted at GE Corporate Research & Development.

He also described reduction in the residual stress uncertainty bounds considered in the mitigation of SCC based on induction annealing and laser peening of the closure welds. Finally he provided updated information in the consideration of improperly heat treated WP with a probability of 2.23×10^{-5} leading to 0.263 WPs over a total 11,770 WPs that will fail immediately after corrosion initiates. Using a Poisson distribution it was computed that in 20 out of 100 realizations at least one WP failed early and 3 realizations had 2 early failed WPs. All these changes led to significant changes in the dose as discussed below.

Patrick Brady (BSC) presented the discussion on waste form process components. He showed updated in-package chemistry calculations claiming that variations in input fluid composition do not affect too much pH changes and new calculations of Np and Pu dissolved concentrations exhibiting lower mean values and more realistic evaluation of uncertainties. He briefly commented on cladding degradation models noting that FeCl_3 was included as a cause of localized corrosion in addition to fluoride.

Robert Andrews (BSC) made a brief presentation describing examples of the Supplemental Science Analyses and Models that were included as part of the supplemental TSPA analyses and was followed by an extensive presentation by Michael Wilson (SNL-BSC) on TSPA Analyses and Models. Wilson discussed the nominal base case TSPA-SR for the nominal scenario (igneous disruption is not included) presenting sensitivity analyses results in which several changes were incorporated into the models such as: (i) an extended climate submodel from 2,000 to 1,000,000 yr, (ii) the dependence of corrosion rates on temperature as presented by Gdowski, (iii) a higher probability of early WP failures, and (iv) radionuclide sorption in the EBS. The main results reported in terms of the dose for the nominal scenario showed that a mean annual dose of 10 mrem/yr is reached after more than 1,000,000 yr in the new analyses presented in the SSPA compared to 70,000 yr in the TSPA-SR base case despite that a residual dose of about 3×10^{-5} mrem/yr is attained from 1,000 to 100,000 yr as a result of the increased probability of early WP failures. The new analyses also revealed that the evolution of mean annual dose is similar for both the high-temperature operating mode and the low temperature operating mode in which the WP temperature is essentially maintained below 85 °C and the preclosure time is extended from 50 to 300 yr. The main contribution to the delayed increase in the dose is attributable to the new corrosion model that, making exception of the early WP failures, gives rise to the first WP failures as a result of corrosion after 100,000 yr without the occurrence of failures due to SCC as in the TSPA-SR base case. Wilson's presentation also includes some subsystem results for the nominal scenario. Kevin Coppersmith (Coppersmith Consultants) made a presentation on unquantified uncertainties and conservatism, using the example of water diversion in the EBS to discuss the treatment of uncertainties. From the analyses of 300 realizations to calculate dose evolution up to 1,000,000 yr he discussed peak dose and time to reach a specific dose, reaching several conclusions regarding uncertainties and conservatism at the system level.

Gerald Gordon (Framatome) made a detailed presentation on evaluation of corrosion processes and the approach adopted for long-term extrapolation and modeling, in which data at CNWRA was used to provide validity to the corrosion rates of Alloy 22 measured in the LTCTF at LLNL.

James Blink (LLNL) presented the evaluation of a range of operating modes in the SSPA. In his presentation the effect of high- and low-temperature operating modes on the expected performance of the various subsystems was analyzed using certain aspects of the specific process models for each subsystem.

Ardyth Simmons (LBNL) talked on the development of multiple lines of evidence for SSPA, the last topic that the NWTRB wanted to have addressed by the DOE. Her presentation was structured around some examples based on the use of natural analogs, simple calculations, sensitivity analyses, observations from site characterization and lab and field experiments. And independent modeling studies. One of her comments that probably deserves more discussion was referred to the lack of enhancement of seepage through rock bolts, claiming that the observation of occasional dripping at the EFS was the result of condensation but not seepage. Particular emphasis was placed on the observations to be included in the Natural Analog Synthesis Report.

Overall conclusions were presented by William Boyle (DOE) in which he reviewed the status in the consideration of the concerns raised by the NWTRB and presented a summary of the follow on work, emphasizing, in addition to the planned work to be conducted by the DOE contractors, the particular significance attributed to both the WP corrosion process and the International TSPA peer reviews.

In the discussion period, among other interventions, Alberto Sagüés (NWTRB) questioned in clear terms the limited data base used in the evaluation of the corrosion rate temperature dependence that had such a significant impact on the dose calculations presented for the two SSPA thermal operating options. As a response, it was noted that there was a combination of other factors too, such as a new consideration of closure weld effects, radionuclide solubility and sorption, and other minor factors, that resulted in the new dose estimates.

Meeting of the Joint NEA/IAEA International Peer Review

Abraham Van Luik (DOE) introduced the members of the International Peer Review Panel composed of 10 experts (Tonis Papp, Chairman, Sweden; David Hodgkinson, UK; Desmond Levins, Australia; Jesus Alonso, Spain; Emmanuel Smailos, Germany; Mel Gascoyne, Canada; Ghislain de Marsily, France; Yasuhisa Yusa, Japan; Claudio Pescatore, OECD/NEA and Phil Metcalf, IAEA), presented the objectives of the peer review of the TSPA-SR, and describe the scope, emphasizing the open nature of the process and listing the schedule, which include a final report to be issued in an open meeting in January-February 2002. This introductory presentation was followed by presentations made by DOE contractors and subcontractors covering the various aspects of the TSPA-SR. These presentations are briefly summarized below because the subject matter is known to the NRC/COWRA staff.

Bob Andrews (BSC) introduced the Yucca Mountain site geology and hydrology to the panel and Larry Trautner (BSC) provided an overview of the WP design. Peter Swift provide both an introduction to the TSPA-SR and a more detailed discussion of the different abstracted models, following a brief description of various process models. Results of various TSPA-SR calculations were shown. Michael Wilson (SNL) presented discussions in thermal hydrology and chemical environments, and unsaturated and saturated zone

flow. WP and drip shield degradation model was presented by Kevin Mon (BSC) and an overview of the waste form degradation model by Rob Rechar (SNL). Bill Arnold (BSC) presented the radionuclide transport in the saturated zone, Anthony Smith (BSC) discussed the biosphere, and Peter Swift (SNL) provided the modeling for igneous disruption. A summary of the TSPA-SR results was presented by Michael Wilson (SNL) while David Sevougian (BSC) provided in his presentation a detailed discussion of sensitivity and barrier importance analyses.

In the final presentation Van Luik provided the programmatic and regulatory context for the proposed repository at Yucca Mountain and emphasized the significance of the possible site recommendation in the development of this national program.

IMPRESSION/CONCLUSIONS:

The attendance to the NWTRB meeting was highly beneficial because the meeting provided an opportunity to have an updated view of the work conducted by the DOE after issuing the TSPA-SR. It was, however, a surprise to find that the new TSPA calculations contained in the SSPA are based in modifications of abstracted models without having developed in certain cases (i.e., corrosion rates) a more solid technical bases and a valid database, particularly because these changes have a significant effect on the dose even though the mean annual dose still remains very low after the 10,000 yr regulatory period.

The attendance to the kick-off of the International TSPA-SR peer review panel was useful and informative to calibrate the reaction of the invited peer reviewers to the DOE approach to PA

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

Careful review of the SSPA will be needed because many assumptions and model modifications imply a significant change with respect to the TSPA-SR.

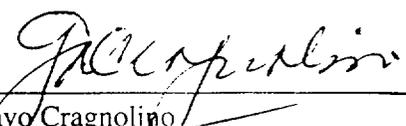
RECOMMENDATIONS:

Future attendance to these type of meetings is useful to keep track of the DOE program.

REFERENCES:

The handouts of the various presentations are available upon request from the author.

SIGNATURES:



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Staff Scientist

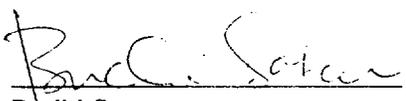
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