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COST UNCERTAINTY FOR DIFFERENT LEVELS OF TECHNOLOGY MATURITY

A Summary submitted for consideration by the Program Advisory Committee for presentation at WM'97, 2-7 March 1997 in Tucson, AZ.

Applicable to Session 8.1 Cost Effectiveness (Cost/Benefit)

August 7, 1996

MASTER

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DISCLAIMER

COST UNCERTAINTY FOR DIFFERENT LEVELS OF TECHNOLOGY MATURITY

TOPIC

It is difficult at best to apply a single methodology for estimating cost uncertainties related to technologies of differing maturity. While highly mature technologies may have significant performance and manufacturing cost data available, less well developed technologies may be defined in only conceptual terms. Regardless of the degree of technical maturity, often a cost estimate relating to application of the technology may be required to justify continued funding for development. Yet, a cost estimate without it's associated uncertainty lacks the information required to assess the economic risk. For this reason, it is important for the developer to provide some type of uncertainty along with a cost estimate. This study demonstrates how different methodologies for estimating uncertainties can be applied to cost estimates for technologies of different maturities.

For a less well developed technology an uncertainty analysis of the cost estimate can be based on a sensitivity analysis; whereas, an uncertainty analysis of the cost estimate for a well developed technology can be based on an error propagation technique from classical statistics. It was decided to demonstrate these uncertainty estimation techniques with (1) an investigation of the additional cost of remediation due to beyond baseline, nearly complete, waste heel retrieval from underground storage tanks (USTs) at Hanford; and (2) the cost related to the use of crystalline silico-titanate (CST) rather than the baseline CS100 ion exchange resin for cesium separation from UST waste at Hanford.

ORIGINALITY/AUDIENCE INTEREST

The issue of demonstrating cost savings for technology development has been raised to a greater level of significance with the increased Congressional focus on balancing the budget. However, determining a cost estimate without it's associated reliability provides the decision maker no information regarding the economic risk. As demonstrated by this study, there is no single all inclusive methodology for determining cost estimate uncertainties. The suite of methodologies available are limited only by the creativeness of the analyst, and their ability to communicate the results in a useful fashion.

In conducting this study it was necessary to make numerous simplifications in the process model in order to make the analysis manageable. Complex waste remediation system process models have existed for some time but have a tendency to remove the analyst from the cost issues. Furthermore, such complex models are poorly suited to the less well defined performance parameters of advanced technologies. Consequently, a significant effort for this study was the development of a simple generic process/cost model which represented UST waste remediation across the Department of Energy complex.

CONCLUSIONS

A sensitivity study was used to determine the cost of heel retrieval at Hanford. The additional cost of achieving 99% waste retrieval from USTs at the Hanford Site, versus the cost of retrieval with only the existing baseline technologies of past-practice sluicing (PPS) for single-shell tanks (SSTs) and mixer pumps (MPs) for double-shell tanks (DSTs), has been estimated by this study to range from $3- to $4.5-billion. This estimate is not based on specific technologies for retrieval of the heel, but rather the heel retrieval rate and a generic capital cost for the additional equipment. Since this approach did not consider specific technologies, a range of performance and capital costs were used which produced the sensitivity analysis results of Figure 1.

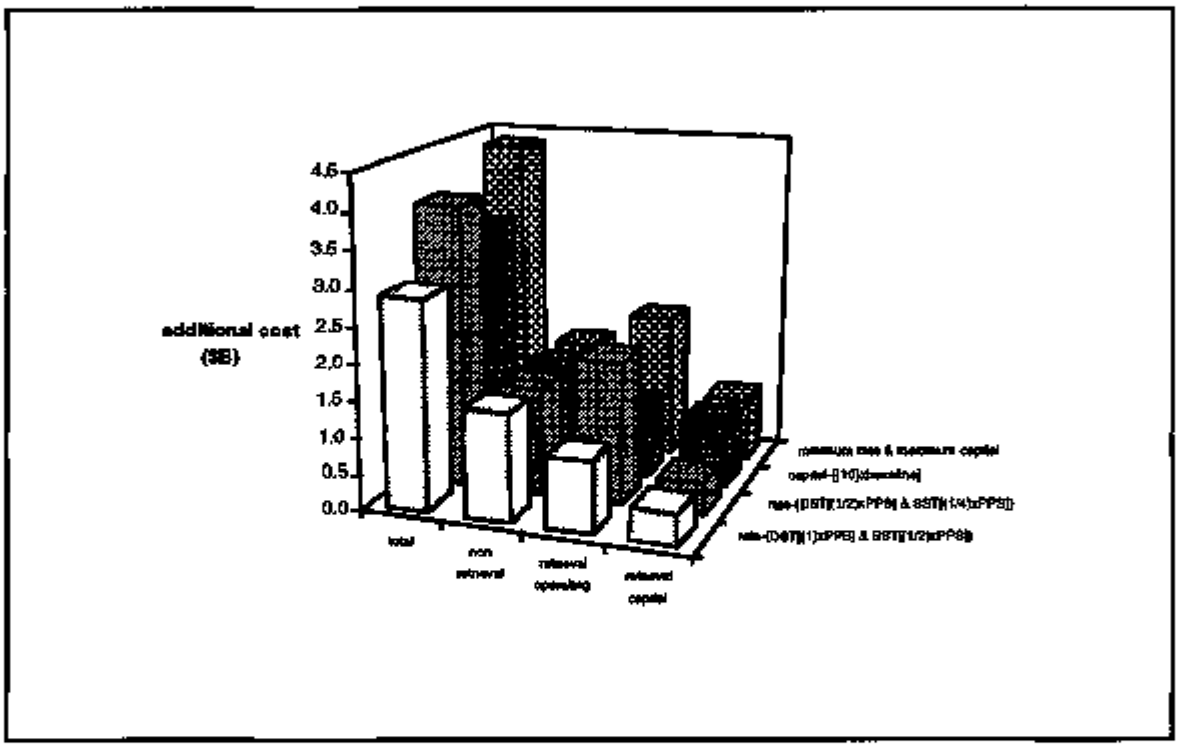

Figure 1. Beyond baseline costs for Hanford tank closure at 99% retrieval

The cost range for retrieving 99% of the tank waste at Hanford, versus the baseline retrieval of 85% of the tank contents for SSTs and 90% of the tank contents for DSTs, can be summarized as follows. Assuming the heel retrieval rate for DSTs ranges from 1/2 to one-times the baseline PPS rate, and for SSTs ranges from 1/4 to 1/2-times the baseline PPS; and assuming that the additional capital cost for heel retrieval depends only on the pumping system and not the existing waste transfer system, and ranges from one-times to ten-times the baseline PPS pumping system; then the additional cost for retrieval of 99% of the tank waste ranges from $3- to $4.5-billion.

An error propagation analysis was used to determine uncertainty associated with the estimate of the cost difference between the use of CS100 and CST ion exchange resins for cesium separation of UST waste at Hanford. A simplified process/cost model developed for this study was coupled with statistical analyses to determine the uncertainty associated with the cost difference estimate. The overall cost difference and it's associated uncertainty are shown in Figure 2.

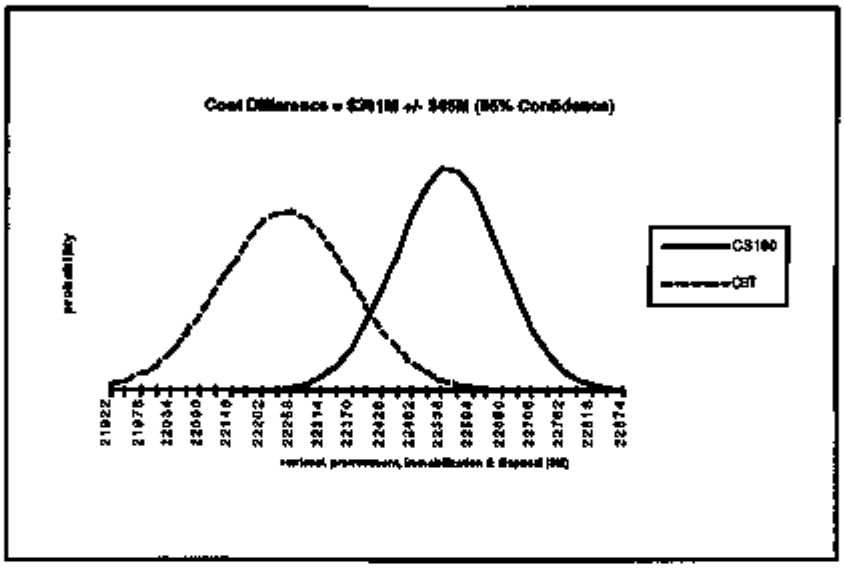

Figure 2. Cost savings uncertainties associated with the use of CST rather than CS100 ion exchange resin at Hanford.

The costs difference and it's associated uncertainty for the use of CST rather than the baseline CS100 ion exchange resin for cesium separation at Hanford can be summarized as follows. It can be stated with 95% confidence that the cost for remediation of UST waste at Hanford will be at least $256-million less, and not more than $346-million less, if CST resin is used rather than CS100. This is within the context of the resin performance and cost data uncertainties used as the basis for the final calculations.

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March 2-7, 1997

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To assist international participation we have added the names of contact people outside the US for as many topics as possible. The topics selected for WM'97 will have invited and contributed papers involving research, development and operational experience in nuclear waste, mixed waste, mill tailings, environmental restoration, waste management, and decommissioning. Papers concerning national and international agreements and regulations governing these topics as well as the impact of these activities on the environment are also solicited. Interested contributors to the meeting are invited to submit extended summaries on a 3½" diskette and 3 hard copies. A single copy by fax will be accepted but the 3½" diskette and 3 hardcopies must follow by overnight mail. The disk is necessary for publishing to the World Wide Web (WWW), which we are considering in order to make the abstracts available to the Program Advisory Committee before the Paper Review. The Program Advisory Committee will be provided with an access code so that only they will be able to access this information two weeks prior to the Paper Review. The authors will be required to approve placing their summary on the WWW. Such approval has no influence on acceptance of the summary.

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The summaries will undergo critical technical review by the PAC to determine if they meet the criteria of technical content, significance and subject. The summary should be long enough to convey to the committee the substance of your proposed paper and its meeting of the stated criteria. Summaries submitted after due date may not be considered. Concerns about the quality of some papers which could be attributed to inadequate preparation led to our new policy of requiring that full papers be written and reviewed before the presentation. This process will also permit much earlier publication

...ow the schedule listed below:

Summary due by ..... August 16, 1996
Paper Review ..... September 16, 1996
Draft Full Papers ..... November 15, 1996
Reviewer Comments to Author .. December 15, 1996
Final Approved Papers Due ..... February 3, 1997

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WM'97 Topics

Topics are listed under "Tracks" designed to highlight specific interests. There is no longer a need for the words US or International since all sessions are open to papers from all countries and are limited only by technical content and relevance. In the event that an entire session deals with a given International group then we will identify the group doing the organization of the session. All topics include Regulatory, Standards, Technology, QA, Risk Assessment, Fate and Transport Modeling and Monitoring where appropriate.

GENERAL SESSIONS

1.0 Nuclear Waste Policies and Programs-Lawrence Harmon, MACTEC, V-(301)353-9444, F-(301)353-9447; Edward J. Bentz, Jr., E. J. Bentz & Assoc., Inc., V-(703)455-7469, F-(703)-912-6578

- 1.1 Plenary-Roy G. Post, WM Symposia, Inc., V-(520)624-8573, F-(520)792-3993, E-mail-wmsym@basix.com (*rgp@wmsym.org; Morton E. Wacks, U of AZ, V-(520)624-8573, F-(520)792-3993, E-mail-wmsym@basix.com (*mew@wmsym.org) *address will be changing soon
- 1.2 Programs and Progress-Lawrence Harmon, MACTEC, V-(301)353-9444, F-(301)353-9447; Pierre Barber, ANDRA, V-33-1-46-11-8068, F-33-1-46-11-8268
- 1.3 Regulatory Compliance-Edward J. Bentz, Jr., E. J. Bentz & Assoc., Inc., V-(703)455-7469, F-(703)-912-6578; Donald E. Wood, WHC, V-(509)376-7832, F-(509)372-1033, E-mail-Donald_E_Wood@rl.gov
- 1.4 Health and Safety Issues-Carol A. Peabody, USDOE, (202)586-0201, F-(202)586-0916

2.0 High-Level-(Including Spent Fuel), Transuranic- and Long-Lived-Waste-Marshall J. Anderson, BDM Federal, Inc., V-(301)601-5382, F-(301)601-5426, E-mail- manderso@bdm.com; Jim W. Voss, Golder Associates International, V-(206)556-5590, F-(206)556-5595; Leif G. Erikkson, Advanced Sciences, Inc., V-(505)887-1079, F-(505)887-5494; Joachim Fleisch, WAK, V-49-7247-88-2230, F-49-7247-88-2144

- 2.1 Status-Myron Kaczmarsky, Raytheon Engineers & Constructors, V-(212)839-3296, F-(212)839-3269; Warren Bodily, Westinghouse Electric Corp., V-(505)234-8990, F-(505)887-2116; Leif G. Erikkson, Advanced Sciences, Inc., V-(505)887-1079, F-(505)887-5494; Jurg Schneider, NAGRA, V-011-41-56-4371111, F-011-56-4371207
- 2.2 Concepts under Investigation (Including Environmental Studies)-Harry Babad, Westinghouse Hanford Co., V-(509)373-2897, F-(509)373-3196, E-mail-harry_babad@rl.gov; John Mathieson, UK Nirex, V-44-1235-825606, F-44-1235-825459, E-mail-100661.3164@compuserve.com
- 2.3 High Level Tank Waste Remediation*-Harry Babad, Westinghouse Hanford Co., V-(509)373-2897, F-(509)373-3196, E-mail-harry_babad@rl.gov; Roy D. Walton, Jr., Argonne National Lab., V-(301)948-0698 x-24, F-(301)990-1929; Ted McIntosh, USDOE, V-(301)903-7189, F-(301)903-8506

3.0 Low/Intermediate Level (Including Very Low Level Waste) and Mixed Waste Treatment Stabilization & Disposal-Lloyd McClure, Lockheed-Martin IdahoTechnologies Co., V-(208)526-1170, F-(208)526-5142; M. Jorda, ANDRA, V-33-1-46-118367, F-33-1-46-11-83-48; Leon C. Borduin, LANL, V-(505)667-3150, F-(505)665-2897; Radovan Kohout, Kohout & Associates, V-(416)488-9466, F-(416)488-2007

- 3.1 Status-Gary Benda, Consultant, V-(803)345-2170, F-Same; K.W. Han, IAEA, V-43-1-2060-22672, F-43-1-20607, E-mail-hank@nepo1.iaea.or.at
- 3.2 New Stabilization and Disposal Concepts under Investigation (Including Vitrification)-Paul Kalb, Brookhaven National Lab., V-(516)344-7644, F-(516)344-3486, E-mail-kalb@bnl.gov; A. Jouan, CEA, Marcoule, V-33-66-79-63-76, F-33-66-79-60-30, E-mail-milhes@cea.fr
- 3.3 State Compacts Status*-David E. Stewart, Bechtel Savannah River, V-(803)208-0541, F-(803)208-8117; Ali Yazdi, Bechtel Environmental Inc., V-(423)220-2340, F-(423)220-2103, E-mail-axyazdi@am@oml; Holmes Brown, Afton Associates, V-(202)547-2620, F-(202)547-1668

4.0 Transportation and Packaging (Including Control)-R. Richard Yoshimura, Sandia National Labs., V-(505)845-8181, F-(505)844-0244, E-mail-hryoshi@nd.sandia.gov; Carole B. Bentz, E. J. Bentz & Assoc., Inc., V-(703)455-7469, F-(703)912-6578; B. Kirchner, Transnucleaire, V-33-1-4069-7678, F-33-1-40-69-7701

- 4.1 High Level and Transuranic Waste-Warren Bodily, Westinghouse Electric Corp., V-(505)234-8990, F-(505)887-2116; C.F. Wu, Westinghouse Electric Corp., V-(505)234-8384, F-(505)885-4562; Carole B. Bentz, E. J. Bentz & Associates, Inc., V-(703)455-7469, F-(703)912-6578
- 4.2 Low/Intermediate Level Waste-Al Grella, Grella Consulting Inc., V-540-972-2538, F-Same, E-mail-algrella@pc-central.com; F. DeCamps, ONDRAF/NIRAS, V-32-2-2121060, F-32-22-185165
- 4.3 New Concepts under Investigation-Richard Rawl, IAEA, V-43-1-2060-21260, F-43-1-20607; Lawrence Harmon, MACTEC, V-(301)353-9444, F-(301)353-9447

5.0 Environmental Restoration-Gary Benda, Consultant, V-(803)345-2170, F-Same; A. Freitag, Bechtel Hanford Inc., V-(509)375-9687, F-(509)372-9117

- 5.1 Status-A. Scott Dam, BNFL Inc., V-(703)385-7100, F-(703)385-7128
- 5.2 New Concepts Under Investigation-Edward L. Helminski, Exchange Monitor Publications, V-(202)296-2814, F-(202)296-2805; K. Komorowski, BMBF, V-49-228-57-3758 (or 3759), F-49-228-57-3605; Don Clark, IAEA, V-43-1-2060-26102, F-43-1-20607, E-mail-Clarkd@NEP01.IAEA.OR.AT
- 5.3 Decontamination and Decommissioning-A. Freitag, Bechtel Hanford, Inc., V-(509)375-9687, F-(509)372-9447; A. Sheil, BNFL UK Group, V-019467 74830, F-019467 71193; S. Halaszovich, KFA, V-49-2461-61-3207, F-49-2461-61-2460

6.0 Utility Waste Management-C. Clint Miller, Pacific Gas & Electric Co., V-(805)545-4582, F-(805)545-3459

- 6.1 At Reactor and Away From Reactor Fuel Storage-C. Bonnet, SGN, V-33-1-30-587498, F-33-1-30-587628; Ramesh Dayal, Ontario Hydro,