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APPROACH TO MIDCOURSE EVALUATION OF MECHANICAL INTEGRITY TESTING

SUBMITTED TO
DR. JENTAI YANG
OFFICE OF DRINKING WATER
U.S. ENVIRONMENTAL PROTECTION AGENCY

JANUARY 1983

BOOZ-ALLEN & HAMILTON, INC.
UNDER THE DIRECTION OF
GERAGHTY & MILLER, INC.

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ACKNOWLEDGEMENT

This report was prepared by Booz, Allen & Hamilton, Inc., under the direction of Geraghty & Miller, Inc. The Booz, Allen project manager was Dr. Joanne Wyman. She was assisted by Mr. Walter Mardis of Booz, Allen. The Geraghty & Miller project manager was Mr. William Thompson, and Mr. Roger Anzzolin was the EPA task monitor.

T A B L E O F C O N T E N T S

APPROACH TO MIDCOURSE EVALUATION OF MECHANICAL INTEGRITY TESTING

On June 24, 1980 the U.S. Environmental Protection Agency (EPA) issued final regulations for the Underground Injection Control (UIC) program. These rules require a more extensive midcourse program evaluation than EPA had set forth in the proposed rules.[1] Accordingly, EPA's Office of Drinking Water (ODW) asked Geraghty and Miller,Inc. (G&M) and Booz, Allen & Hamilton, Inc. (BA&H) to expand our initial analysis on the conduct of the midcourse evaluation to include the mechanical integrity testing (MIT) requirement for Class II wells.[2] In response to ODW's request, we developed baseline information for the MIT review similar to that we prepared for the AOR midcourse evaluation.[3] This information is summarized in Exhibit 1 and the accompanying narrative.

1. OVERVIEW OF THE MECHANICAL INTEGRITY DEMONSTRATION REQUIREMENT

The principal purpose of requiring well operators to demonstrate mechanical integrity is to ensure:

- The absence of significant leaks in the well casing, tubing, or packer
- The absence of significant fluid movement into an underground source of drinking water through vertical channels adjacent to the injection well bore.

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1 The rules EPA proposed in April 1979 required a midcourse evaluation only of the costs and benefits of the Area of Review requirement for Class II wells. The final rules, however, extend the midcourse evaluation to the AOR for Class I and III and to the mechanical integrity testing program for Class II.

2 Prior to promulgating final rules, EPA asked us to assist in designing the midcourse evaluation of AOR. After issuance of the final rules, EPA asked us to extend our initial analysis of alternative study methodologies to mechanical integrity testing in lieu of preparation of an AOR midcourse evaluation study manual.

3 See Geraghty & Miller, Inc. and Booz, Allen & Hamilton, Inc., Development of Midcourse Evaluation Methodology (Task I Report: Evaluation of Alternatives), June 17, 1980 pp. 1-5.

In its April 1979 version of the proposed rules, EPA called for the use of eight tests to determine the likelihood of leaks and the use of either well records or tests to determine the existence of fluid movement. The requirements covered Class I, II, and III well operations.

In the preamble to the final regulations, EPA indicates that it now has serious doubts about the reliability of well records as indicators of the absence of fluid movement. Accordingly, for Class I and III operations the Agency now requires the use of formal tests. For Class II operations, however, because of the large number of wells and the Safe Drinking Water Act (SDWA) requirement that regulations not interfere with oil and gas production, EPA continues to allow the use of well records to demonstrate mechanical integrity. At the same time, under a modified Section 146.08, EPA requires a sample of Class II wells to conduct mechanical integrity tests. Wells in the sample are to be ones which initially use well records in place of temperature or noise logs to determine the likelihood of fluid movement.

2. OBJECTIVES OF THE MIT MIDCOURSE EVALUATION

The purpose and objectives of the AOR and MIT midcourse reviews differ markedly. The purpose of the AOR review is to ascertain whether EPA regions and the states have implemented the requirements effectively. By contrast, the purpose of the MIT review is to establish a mechanical integrity demonstration procedure which is more economical and less time consuming than universal formal testing, while still guaranteeing a high degree of accuracy.

Establishment of a screening procedure would be one possible approach. EPA believes that it may be possible to identify certain well characteristics (such as depth, age and type of cementing) which are reliable indicators of well integrity. For each well, well records will indicate whether the well has the characteristics indicative of mechanical integrity. Wells not having those characteristics will have to perform formal tests.

In order to determine the feasibility of this approach, EPA intends to compare the mechanical integrity demonstration results from the well record reviews with those from the formal tests. Key questions the Agency needs to consider in analyzing the data are:

- How accurate are Class II well records in identifying mechanical integrity problems?

- What savings to well owners/operators result from the use of well records instead of noise and temperature logs?

- What are the administrative impacts on state regulatory agencies of substituting well records for log data?

In addition, the Agency is interested in examining the applicability of any Class II screening procedure to Classes I and III. For each of these key study questions, Exhibit 1 displays five specific study objectives for answering the key questions. For each objective, it discusses the study rationale, the data needed to respond to each question, and methodological or procedural problems in conducting the analyses.

3. APPROACH TO THE CONDUCT OF THE MIT MIDCOURSE REVIEW

EPA's planning activities for the MIT evaluation must differ from those for the AOR review in order to be consistent with differences in:

- Measurement of objectives
- Level of regulatory detail.

Unlike the AOR review, in which measuring administrative effectiveness must serve as a surrogate for measuring achievement of substantive program objectives,[1] the MIT review directly measures substantive and administrative objectives.[2] Thus, the MIT review will require a more detailed, but less extensive in scope, collection and analysis of program organization, activity, and resource data. In addition, unlike the proposed rules for the AOR midcourse review, the final regulations for the MIT evaluation contain specific guidance on the midcourse review design. Whereas EPA had the opportunity for the AOR review to consider three alternatives (two of which involved sampling), EPA must evaluate sampling data for the MIT. Furthermore, the regulations require the states to comply with the following in drawing the sample:

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1 For an explanation of the difficulties, see Geraghty & Miller, Inc. and Booz, Allen & Hamilton, Ibid, pp. 5-6.

2 A substantive objective is to determine well record reliability; an administrative one is to determine changes in the administrative burden resulting from use of well record data instead of log data.

EXHIBIT 1
Overview of Study Objectives For MIT Midcourse Review

STUDY OBJECTIVES	BASIS OF ANALYSIS	NECESSARY DATA FOR THE ANALYSIS	ADDITIONAL QUESTIONS
1. Determine if reviews of well records are suitable substitutes for temperature or noise logs in identifying mechanical integrity problems in outer casings or well bores.	A comparison will be made of the results of well record analyses for a sample of Class II wells compared to results of noise and temperature logs conducted for the same sample. The key concern is the precent of variation between the findings of the two analyses and the characteristics of wells for which variation occurs.	. Relevant data on a random sample of Class II wells as required in Section 146.25 of the UIC regulations including: - results of well record reviews - characteristics of wells - characteristics of well record data . Type of state regulations and requirements for injection wells in effect prior to the implementation of the UIC program.	. What constitutes an acceptable level of error? . Do the variations in accuracy differ based on certain characteristics of the subject well such as: - age? - location? - past state regulatory practices? - condition and detail of well records? - type of cementing techniques employed? - other factors? . For how many wells were well records incomplete or inadequate, thus necessitating use of temperature or noise logs?
2. Determine if there are any technical factors which might preclude reliance on well records as an indicator of well integrity.	The analysis will identify any technical problems which appear to cause variations between the results of record reviews and the results of formal mechanical integrity testing. The significance of these factors will be assessed and an attempt will be made to identify means for avoiding or overcoming them.	. Examples of well integrity problems found in formal mechanical integrity tests which were not identified in well record reviews. . Evidence on how well records could be improved so as to provide necessary information.	. Is there sufficient capacity on the part of well testing firms to manage all of the potential need for mechanical integrity testing?

EXHIBIT 1 (Continued)

STUDY OBJECTIVES	BASIS OF ANALYSIS	NECESSARY DATA FOR THE ANALYSIS	ADDITIONAL QUESTIONS
3. Determine if major cost or time differences exist for well operators between well integrity analyses based on record reviews and those based on mechanical integrity tests.	The analysis will attempt to determine if reliance on record reviews rather than on formal mechanical integrity testing will result in any time or cost savings to well operators/owners and hence any reductions in the overall cost/production impact of the UIC regulations.	. Empirical data on costs of reviewing well records and costs of performing temperature and/or noise logs for the sample of wells covered in the survey. . Analyses of time involved in both types of reviews including: - Overall time from start to finish of each type of review - Actual well down-time attributable to each type of review - Time spent in administrative analyses of data supplied to state regulations for each type of review.	. Can downtime attributed to mechanical integrity listing delays be distinguished from delays associated with other factors? . Do time delays or cost increases related to mechanical integrity testing appear to vary according to: - The state in which they are performed - The conditions of existing well records - The age of the well - Other factors.
4. Determine if the administrative burden for state regulatory agencies varies depending upon the type of review conducted by Class II well operator/owners.	The analysis will assess state agency review procedures for owner/operator submittals based on well record reviews and for submittals based on temperature or noise logs to determine: - The length of time associated with the state evaluation - The types of additional supporting information which the state agency must obtain - The types of personnel required to conduct the evaluation - Numbers of on-site inspections of wells.	. Review calendar time frames . Number and skills of individuals involved in reviews . Manhours spent on collecting supporting information . Number and types of site inspections.	. Does not having log data on well integrity adversely effect any other aspect of the state's UIC program? . Do states typically have or can they acquire the skills necessary to interpret mechanical integrity testing data?

EXHIBIT 1 (Continued)

STUDY OBJECTIVES	BASIS OF ANALYSIS	NECESSARY DATA FOR THE ANALYSIS	ADDITIONAL QUESTIONS
5. Determine if the use of well records as a substitute for log data could be acceptable for other classes of wells.	If there is a strong correlation between the conclusions reached by reviewing well records and those resulting from temperature and noise logs, EPA may wish to allow Class I and III well owner/operators to also use well records. This analysis will assess the feasability of doing this. In part, it will entail a comparison of any technical differences between Class II wells and I and III wells.	. Number of Class I and III wells which would be affected . Potential cost and time savings of expanding use of well record reviews . Percentage of Class I and II wells which have adequate and complete well records.	. Are there any factors which would increase the likelihood that well records would be less accurate in determining mechanical integrity for Class I or III wells than for Class II wells. . Would there be a greater risk from having misjudged Class I or III wells than for mid-judging Class II wells.

- Sampling must be formal, random selection.
- It must be done on a field or pool basis and be statistically representative of the fields or pools.
- At least 50% of the wells tested must be existing ones.

Consequently, EPA is in a position to begin detailed planning. Some of the principal issues it must address during this planning phase include the format of data submittals; system of data storage, retrieval and analysis; frequency of data analysis and aggregation;[1] and lead office/work group for conducting the analysis.

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1 For example, EPA must determine whether to conduct the analysis after each six month reporting period or after 12 months, 18 months, or 24 months.