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Martin W. McCann Jr.
Jack R. Benjamin

December 31, 1997

Mr. Stein Buer
CALFED Bay-Delta Program
1416 Ninth Street Suite 1155
Sacramento, California 95814

Dear Mr. Buer:

It was a pleasure to talk with you recently regarding the CALFED Program and its' need to assess the reliability of the water supply system and to manage the risk to land use, local and state economies, and infrastructure associated with the performance of the delta levee system. As I mentioned there are a number of attributes of a risk-based evaluation that I believe can contribute to an understanding of the integrity/vulnerability of the water supply system which can facilitate decisions that must be made now and in the future.

The use of risk-based methods to evaluate civil infrastructure systems is well-established in engineering practice. In fact, risk-based assessments are becoming a necessary and integral part of planning studies, safety assessments, lifeline analysis, system design, regulatory standards (i.e., acceptable risk and performance criteria), and operations and maintenance planning. The reason for increased application of these methods is fairly straightforward. These include:

- ✔ increased fiscal constraints,
- ✔ demand for improved reliability of services,
- ✔ a recognition by public officials and the public that 'absolute' safety or reliability cannot be achieved and thus trade-offs with the risks associated with system failures, cost, environmental impact, and other socio-economic impacts must be made, and,
- ✔ a basic mandate to 'do more with less'.

The framework of a risk-based assessment is inherently suited to evaluate the performance of a system, identify its vulnerabilities, and assess the consequences and risks (e.g., economic, health and safety) resulting from system failure. A key attribute of a risk-based

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assessment is the identification and evaluation of uncertainties associated with random events (e.g., floods, earthquakes, future subsidence, invasive species) as well as those that stem from deficiencies in knowledge or data. In addition, a risk-based assessment takes a systems level approach to the evaluation of multi-component systems. The system analysis:

- ✔ evaluates individual component (e.g., structure, equipment) failure modes/ vulnerabilities,
- ✔ consists of a logic model that assesses system failure modes/vulnerabilities based on the physical and/or functional inter-relationship of individual components as they contribute to a system's performance, and
- ✔ assesses the consequences/impacts (e.g., economic, environmental, health and safety) resulting from system failures on the basis of a defined, collectively exhaustive (i.e., complete) set of scenarios.

Once complete, a risk-based assessment provides the decision-maker with a comprehensive model of a system, including its vulnerabilities and the relative importance (quantitatively characterized) of individual components and their failure modes to system performance.

While the framework provided by a risk-based assessment is ideally and uniquely suited to evaluate the performance of complex civil infrastructure systems, there are a number of key issues related to the implementation of such an analysis. These issues pertain to the organization and implementation 'process' (i.e., how the study is carried out). They include:

1. Decision Oriented - The framework and performance of a risk-based assessment must be carried out to support a decision process. That is, the scope of the assessment, its depth (level of detail), and the products it provides must be clearly defined to meet the specific objectives and needs of a decision-making process. Within the context of a decision process, there are specific questions that must be answered and/or intermediate and final decisions that must be made. These questions/decisions must be reasonably, if not explicitly, understood at the onset of a risk study in order that an appropriate scope for a study can be established. This includes an understanding of the specific products (e.g., numeric results) that must be generated. In this context, a risk-based assessment could logically be called a decision support assessment.

2. Project Organization - a decision support assessment is, necessarily, an integrated evaluation that requires the input and involvement of engineers and scientists that have an in-depth understanding of the physical phenomena and systems that are being modeled. In addition to engineers and physical scientists, analysts with experience and specific expertise in performing risk-based assessments are required. These 'risk analysts' establish and

implement the scope of a project, provide the technical input to develop the risk/reliability model for a system, coordinate the evaluations and input of engineers and scientists involved in individual parts of the study, and perform the risk quantifications.

3. Information - There is a persistent problem when dealing with major civil infrastructures with regard to the level and quality of information. It seems there is never enough information, and what you have is not what you want. While there is some truth to this, a risk-based assessment is the technical tool available to the engineer, scientist and decision maker that can formally identify, assess and incorporate the epistemic (information and knowledge-based) uncertainties into an evaluation and ultimately account for them decision making.

Enclosed for your information are a couple of documents that relate to the subject. They are:

1. Brief write-up on the idea of managing a civil infrastructure system where the manager must balance demands for reliability of services, costs of operations and maintenance, risks of failure, etc.

2. An outline for a levee system risk assessment project.

3. A report that describes the use of risk-based concepts in a planning study to guide the selection of future dam sites and to establish a performance goal for dam design.

4. A report on a seismic risk assessment for a government reactor. The study was used to determine the risk of failure. If the seismic risk was considered too high the study provided input on the components and systems that were the dominant contributors to risk and therefore should be the focus of modification/upgrade.

After the first of the year, I will plan to give you a call to set up a time when we might get together. Possible dates on our calender include January 15, 22, or 23.

Best wishes for the new year.

Very truly yours,

Marty

Martin W. McCann, Jr.
President

Enclosures

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Martin W. McCann Jr.
Jack R. Benjamin

April 22, 1997

Mr. Ron Ott
CALFED Bay Delta Program
1416 9th Street Suite 1155
Sacramento, California 95814

Dear Ron:

It was a pleasure to meet you last Friday. I enjoyed sharing our mutual Stanford experience and hearing about the CALFED Project. As you requested, I am enclosing information about our firm. For your information, I am also enclosing a copy of the proposal we sent to Curt Schmutte. If you have any questions regarding the proposal, please feel free to give me a call. We look forward to the opportunity to be of service to the CALFED Program.

Very truly yours,

Marty

Martin W. McCann, Jr.
President

Enclosure

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