[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

Technology Information	
Area	1 through 6 (Select the number from "Areas of Technologies Requested")
Title	Environmental Management and Engineering Services
Submitted by	AECOM Technical Services, Inc.

1. Overview of Technologies (features, specification, functions, owners, etc.)

Introduction

In response to Japan's Ministry of Economy, Trade, and Industry's (METI) request for information (RFI), AECOM Technical Services, Inc. (AECOM) is respectfully submitting this brief statement of qualifications. The information provided is intended to introduce you to AECOM and describe our qualifications and corporate relationships that can support the management of contaminated water at the Fukushima Daiichi Nuclear Plant. In accordance with the RFI, this submittal specifically addresses the following areas:

1. Accumulation of contaminated water (storage tanks)
2. Treatment of contaminated water (tritium)
3. Removal of radioactive materials from the seawater in the harbor
4. Management of contaminated water inside the buildings
5. Management measures to block groundwater from flowing into the site
6. Understanding the groundwater flow.

AECOM is a multi-discipline, world-wide professional services company that can evaluate the technical needs of the projects and provide the most efficient and effective solutions. AECOM is not proposing any specific technology to be reported to the Committee on Countermeasures for Contaminated Water Treatment. AECOM is, however, proposing to support the team in the evaluation of the projects and in designing solutions that will incorporate the most effective technologies available. To accomplish this, AECOM recommends the following actions (in this order) prior to procurement of any individual technologies for treatment or containment:

1. Understand the site: Develop a conceptual site model (CSM) for the Fukushima site. This CSM would include a detailed description of the groundwater, surface and subsurface geology, and tidal impacts on contaminant transport.
2. Reduce the transport of contaminants: Evaluate effective barrier technologies and obtain preliminary and final designs for installation that is consistent with the CSM.
3. Remove and contain contaminated water: Develop a collection and retention strategy and design the appropriate sized system that meets all applicable safety requirements.
4. Treat contaminated water (from tanks and from environment): Develop efficient integrated or stand-alone treatment systems for tritium or other radionuclides.
5. As necessary, develop a strategy to remove radioactive contaminants from seawater in the harbor that is integrated with the CSM.

Conceptual Site Model

Once fully developed, the CSM of the Fukushima Daiichi Nuclear Power Plant site will provide the information desperately needed to manage the issues associated with the continuous contamination of groundwater at the site and the transport mechanisms that result in contamination of the sea water. AECOM proposes to develop the CSM based on a study of the soil, geology and hydrology and other factors impacting movement of contaminants. To develop the CSM, AECOM will organize an international team of geologists, hydrologists, coastal scientists, and modellers that will provide best-in-class support.

Two of the most important tools in developing the CSM are groundwater modeling (using numerical and physical methods) and geophysics.

1. Groundwater Modeling

Predictive numerical groundwater modeling is an important tool for understanding a site and focusing remedial efforts. It provides a solid basis for decision making throughout a site's life cycle, thus reducing costs and providing a clearer pathway to site closure. An existing groundwater model can evolve as additional site data is collected, enabling the project team to evaluate the remedial program based on the latest, most complete understanding of the site. Where appropriate, AECOM incorporates numerical models to select the most cost effective remedy or to optimize an existing system with the ultimate goal of closing the site as soon as possible. For example, fate and transport modeling provides a defensible evaluation of plume stability, particularly at complex sites, and can play a major role in the regulatory acceptance of an exit strategy for a given site. Based on cost estimates from twelve projects where modeling played a key role in the selection of monitored natural attenuation (MNA) as a remedy, $50 million in remediation expenses was saved, resulting in a return on the modeling investment of $56 per dollar spent.

AECOM Areas of Expertise:

- Exit Strategy Development/Site Closure
    - Plume stability analysis
    - Modeling of fate and transport within various media
    - Monitored natural attenuation
    - Calculation of alternative clean-up goals or alternate concentration limits
- Remediation
    - Identification of probable source areas
    - Optimization of remedial actions (e.g., cut-off walls/trenches, in situ treatment, evapotranspiration covers, funnel and gate systems, pump & treat/re-injection)
    - Evaluation of alternative hydraulic control measures (e.g., phyto-remediation, funnel and gate, capping, barrier walls)
    - Hydraulic impacts of in situ stabilization of sediments
    - Comparison of remedial alternatives (i.e., in support of feasibility studies or corrective measures studies)
    - Design of remedial actions (i.e., pump and treat, in situ treatment, injection)

- Resource Development
    - Water supply development
    - Aquifer vulnerability studies
    - Wetlands restoration.

AECOM has the capabilities to tailor its modeling solutions to suit the project objectives and budget. Our personnel have expertise with a wide variety of models and graphical user interfaces, ranging from simple spreadsheet models or calculations to the most complex transient flow and transport models. We even have several models that use AECOM-developed codes. Modeling results can be presented from simple time versus concentration graphs to 3-dimensional renderings or animations. Advanced graphical products are especially helpful for communicating technical material to clients, to regulators, and to the public. Types of modeling available include:

- Flow and solute transport modeling
- Saturated and unsaturated flow conditions
- Multi-species transport involving parent compound decay and degradation product creation
- Multi-phase transport and variable density flow regimes

2. Geophysics

Geophysical methods are conducted at the surface (on land or in marine settings), and in boreholes, measuring physical or chemical contrasts in material properties to better understand subsurface conditions as well as provide scientific rationale and justification for intrusive exploration. Geophysical output and deliverables to clients can range from real-time, plan view maps for buried target location to more complex 3D visualizations for conceptual site model development.

Although drilling and test pit excavations provide direct information on subsurface properties, buried target identification, geology, and contaminant distribution, important considerations need to be made of the expense, risk, health and safety, and information disclosure when undertaking intrusive exploration and sampling programs. Geophysical exploration, when conditions allow and when conducted using experienced personnel, can enhance a subsurface investigation program, and can be used to help reduce risk. Although geophysics should not to be relied on without exploratory data, it can aid in the decision process and promote overall project cost effectiveness.

AECOM's experience includes the following geophysical methods and associated applications:

- Electromagnetics
    - Waste disposal limit delineation
    - UXO/munitions response
    - Groundwater/chloride-impact mapping
    - Utilities/engineering structures locating
    - Dipping fracture zone delineation in bedrock terrains

- Electrical Resistivity/Induced Polarization
    - Geology/bedrock fracture zone detection
    - Groundwater quality/salinity studies
    - Contaminant plume mapping
    - Karst evaluation/sinkhole studies
- Magnetics
    - Ferrous metal detection
    - Utility pipeline mapping
    - Landfill characterization
- Ground-Penetrating Radar
    - Underground storage tank location
    - Engineering structures and utility detection
    - Subsurface void mapping
    - Lithostratigraphy
- Seismic
    - Bedrock surface mapping/rippability studies
    - Groundwater aquifer characterization
    - Sediment thickness mapping/lithostratigraphy

Restrict or Redirect Groundwater Flow

Following the completion of the CSM, AECOM's modeling team will consult with an AECOM environmental and civil engineering team that will develop a strategy for containing and/or redirecting the flow of groundwater. This team, which will include staff experienced with groundwater confinement projects, will examine the use of barrier technologies and pumping technologies to provide the most effective methods for reducing the amount of groundwater being impacted by the contaminated water on the plant site. AECOM will evaluate potential technologies and groups of technologies based on the CSM and if appropriate, numerical simulations. As the CSM must be fully understood to propose a specific technology or method, nothing specific is proposed in this submittal.

Collect and Retain Contaminated Water

As industry leaders in water management and water treatment, AECOM offers our clients unique solutions for the most complex wastewater problems. AECOM's experience in planning, designing and managing water systems dates back more than 100 years. With skills that extend beyond technical knowledge, our scientists, engineers and construction managers have the capability to work on any water project around the World. Our high-level expertise in water and wastewater infrastructure, water resources and alternative project delivery enable us to provide comprehensive solutions for our clients. Through these disciplines, we offer integrated services for total project delivery, covering everything from initial environmental planning studies

to detailed design, construction management, total program delivery operations and maintenance expertise.

We understand the design and engineering requirements of wastewater infrastructure. Our talented wastewater teams around the globe partner with clients to develop plans and sustainable solutions that solve the most challenging wastewater problems. Our experts have worked on some of the most significant wastewater and water reuse projects in the world. From the Boston Harbor cleanup in the U.S. to the Alexandria, Egypt, Wastewater Treatment Plant, to projects in Asia, Australia and Europe, our specialists develop cost-effective treatment systems, including those that use advanced biogas processing to convert waste to energy. Our wastewater engineering capabilities incorporate expertise in:

- Treatment facilities
- Wastewater reuse
- Biosolids management and residuals treatment
- Facility master planning
- Collection systems

As specifically requested for support at the Fukushima Daiichi Nuclear Power Plant, our wastewater professionals can address collection systems at the plant with a focus on system performance, public and worker safety and long-term maintenance in mind.

1. Combined Sewer Overflow/Sanitary Sewer Overflow Wet Weather Controls

In Boston, Massachusetts, we developed and implemented a plan that uses a tunnel storage system to restore one of the city's premiere beaches that is saving rate payers $800 million over the course of the program. With far-reaching experience in wet weather controls, we assist our clients with the development and implementation of long-term combined sewer overflow and sanitary sewer overflow control plans to reduce costs and conserve resources.

2. Pumping Facilities

Our professionals ably tackle the most complex design, construction and operational challenges to deliver large and elaborate pumping stations to our clients across the Americas. Our experience encompasses such far-reaching services as conveyance of dry weather flow and dewatering of deep tunnel networks.

3. Condition Assessment/Pipeline Rehabilitation

When municipalities seek to upgrade their water infrastructure, they turn to our experts for results. In Milwaukee, Wisconsin, for example, as part of the Central Metropolitan Interceptor Sewer Improvement project, we provided inspection, condition assessments, preliminary and final design and construction management for 50 miles of 100-year-old interceptors.

Decontamination of Water

While AECOM has operated countless projects world-wide that have involved the removal of hazardous contaminants and radionuclides from water, our most relevant experience is at the Fukushima Daiichi Nuclear Power Plant. AECOM has previously provided engineering/design services to a key client, Kurion, Inc., to support their expedited design/fabrication/delivery of custom equipment used for the emergency cleanup and recovery activities at the heavily damaged plant.

The Fukushima Recovery Support work was awarded by the Tokyo Electric Power Company (TEPCO) to Kurion, Inc. in the immediate aftermath of the Great East Japanese Earthquake and Tsunami in April 2011, and Kurion turned to AECOM for assistance in developing the design for a skid-mounted ion exchange and pumping system to treat volumes in excess of 30 million gallons of contaminated sea water (used for cooling the damaged reactor cores) to remove highly radioactive cesium (Cs) isotopes. The Kurion cesium adsorption water treatment system includes pumps, Cs adsorption vessels, piping and valving contained within six enclosed skids, together with interconnecting piping and pump controls that interface with other parts of the Fukushima plant's water treatment process. AECOM engineers also provided oversight and support to Kurion during their expedited fabrication and deployment of the skid-mounted equipment to Japan, and post-delivery installation and startup support at Fukushima.

Together with our client, Kurion Inc., AECOM's design team responded decisively to a catastrophic natural disaster to assist TEPCO and the people of Japan in the emergency recovery activities at the Fukushima Daiichi Nuclear Power Station following the unprecedented earthquake and tsunami event in March 2011. AECOM supported Kurion and TEPCO around the clock throughout the project's five-week design/fabricate/delivery cycle and provided timely technical support to Kurion during the system startup effort to assist in overcoming issues contributed to by the fast-tracked emergency nature of the work and difficult working conditions at the project site.

AECOM proposes to expand on this experience and our relationship with Kurion and further utilize the expertise of our engineering, radiological services, and wastewater collection and treatment practices in supporting water decontamination efforts that the plant.

Seawater Treatment

Successfully preventing groundwater from flowing into areas of contamination coupled with controlling other impacted water sources at the site will likely eliminate the need for treatment of seawater. In other words, if the source of contamination to the seawater is eliminated, the natural dilution of the volume of the water in the harbor should effectively reduce contamination levels to below detection limits. However, in the event that the team wishes to consider more proactive countermeasures, AECOM engineers in our environmental and water practices will study the contaminant pathways (part of the CSM) and design an effective treatment approach that is focused on reducing dose to the target population as a primary goal. However, if the designed engineered solution does not provide a measurable reduction in the dose, AECOM will support efforts to minimize the efforts in treating seawater and perhaps shift focus to the remediation of contaminated sediments.

Summary

In summary, AECOM is proposing that decision makers consider a holistic approach to managing the contamination of groundwater and seawater at the Fukushima Daiichi Nuclear Power Plant. There should not be a rush to select treatment or management technologies without first having a full understanding of all mechanisms impacting the site. This understanding is obtained through the development of the CSM. With a robust CSM, the risks associated with the proposed solutions are reduced and the opportunities for successful implementation of confinement, collection, and treatment approaches are greatly enhanced. With AECOM's world-wide experience and unparalleled success in managing water resources, the solutions to the issues at the Fukushima plant are well in reach.

2. Notes (Please provide following information if possible.)

- Technology readiness level

As a professional services company, AECOM stands ready to support the necessary engineering, scientific studies and modeling that must be done to design a successful water management system at the Fukushima Daiichi nuclear power plant. Our efforts will focus on designing a system that includes technologies that are best suited, and preferably field tested, to support a quick and reliable solution. Each individual component of the system must be selected and designed with the other components in mind so that the entire water management system works together in a holistic manner.

- Challenges

The subsurface conditions must be understood in detail prior to designing and implementing groundwater control structures. This understanding includes geologic conditions and current groundwater flow paths. In addition, future groundwater flow paths after implementation must be predicted and understood. The understanding of subsurface conditions come through developing a detailed CSM, a discipline at which AECOM is an industry leader, and the prediction of future groundwater flow paths comes through numerical simulation of that CSM.

- Others (referential information on patent if any) None

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