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**GEOGRAPHIC INFORMATION SYSTEM PLANNING FOR
GEOTECHNICAL AND EARTHQUAKE ENGINEERING
APPLICATIONS AT THE SAVANNAH RIVER SITE, SC (U)**

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**Geographic Information System Planning for Geotechnical
and Earthquake Engineering Applications at the Savannah
River Site, SC**

Richard Lee¹

Abstract

The Savannah River Technology Center (SRTC) of the Savannah River Site is in the planning stages of compiling a geological, geophysical, and seismological data base on an industry standard Geographic Information System (GIS). The system will serve as a tool for management and integration of already collected site data, planning for additional investigations, and for special studies such as seismic hazard and risk analyses for the Savannah River Site (SRS).

Introduction

For the past four decades, the SRS has been subjected to numerous geological and geotechnical investigations in support of facility construction, and waste site development and remediation. Current and past programs at the SRS involve numerous investigators from different departments, and consequently, earth science data and interpretations are scattered among the departments, investigators, and subcontractors. Although GIS technology is used by several groups at SRS, a geotechnical (including earthquake engineering) application has not been developed.

Recent Department of Energy (DOE) Orders (Systematic Evaluation Program, 1991) have put specific requirements on their contractors to compile geological data bases in

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order to coordinate DOE site data gathering, interpretations, and assist in compiling Safety Analysis Reports. Consequently, a major task is underway to select and procure the necessary computer hardware and software tools that will satisfy these data base requirements.

Examples of the spatially referenced SRS data that would reside on the GIS include facilities and lifelines (e.g., reactor and non-reactor facilities, roads, power, communications, water), geologic maps, water well locations, seismic survey line locations, and gravity and magnetic interpretative maps. Because there are significant applications to 3-d data and interpretation display, additional graphics display capabilities will supplement standard GIS graphics display capabilities so that the system will allow construction of stratigraphic "fence diagrams" and material property cross sections. The GIS would serve a library function for geophysical and geological spatial data, and would provide important relational information, e.g., a reference bibliography; individuals or departments that control data, and outline survey locations used for data acquisition.

Tasks for System Development

The ongoing tasks to develop the system include the following steps:

- (1) establish scope of data categories to be captured in the GIS;
- (2) identify reports, already prepared GIS data layers, and other geotechnical data bases to be captured by the system;
- (3) locate and determine "ownership" by departments and individuals of geotechnical data that may or may not have been published or internally reported;
- (4) determine user computational and graphical requirements for the system;
- (5) for the estimated size of the data base and user requirements of system, determine an initial system hardware and software configuration that will be as consistent with existing data bases as possible that can be easily expanded and upgraded;
- (6) develop schedule and staffing requirements for adoption or development of various layers on the system;
- (7) based on schedule requirements, quantity of data, and system configuration, determine the contract basis to operate and maintain the system, select and input data layers, and provide products and training to users of the system;

(8) based on system configuration and number of personnel, determine space, data communications, power, and environment requirements.

Data Requirements for System

DOE Order 6430.1A, and the Systematic Evaluation Program together with the Nuclear Regulatory Commission (NRC) Standard Review Plans were used to develop a detailed list of data "types" that would constitute the data base. That list is available from the author but includes data regional to SRS (< 200 km of SRS), site, and facility specific areas in the following general subject categories:

1. geologic maps
2. active fault parameters that bear on ground motion potential;
2. site-specific amplification factors;
3. soil and rock material properties;
4. historical and instrumental seismicity;
4. geophysical data;
5. paleoseismic data;
6. seismic hazard evaluations;
7. geotechnical engineering (soils) parameters
8. hydrology (groundwater)

We have supplemented these general data categories with requirements from the the NRC Standard Review Plan, for commercial reactors:

- (1) Site and regional geologic and seismic information are required in illustrative form including location of all plant structures, borings, trenches, profiles; relationship between site and regional geology;
- (2) Vibratory Ground Motion: all seismic, geologic, tectonic, and wave propagation characteristics that bear on design ground motion;
- (3) Surface Faulting: data bearing on faulting, structural geology, observed lineaments, exploratory methods;
- (4) Geotechnical data bearing on stability of subsurface materials and foundations and slope stability.

Planned GIS Application to Seismic Hazard and Risk Issues at the SRS

Seismic hazard assessments for facilities at the SRS have historically been approached by both probabilistic and deterministic methodologies. Nearly all hazard

assessments incorporate hypothetical regional and local seismic sources whose occurrence would control specific frequency bands of facility design basis spectra. Recent facility specific geotechnical studies have indicated that there are significant differences in seismic site response at different localities at SRS. There may be significant aspects to the spatial variability of the seismic hazard at the SRS owing to: (1) the effects of basement structure on site response (effects of a Dumbarton Triassic sedimentary basin that crosses under the site and having significantly lower shear velocity than the surrounding crystalline basement; and (2) differences in shallow coastal plain sediment material properties (primarily S-wave speeds). Less significant factors to these differences in facility hazard are spatial differences in source-facility distance (< 10 km from an average source distance of about 120 km), and depth to basement (< 50 m variation of a total thickness of 300 m sediments).

An important application for the GIS technology at SRS are to build data layers for design basis ground motions that account for the spatial variabilities outlined above. The layers can express a hazard surface by peak ground motion value (frequency dependent and produced either deterministically or a value at a selected probability of exceedance. The hazard layers can be combined with layers of facility and lifeline locations, and based on the facility design basis and estimated engineering fragilities, seismic risk estimates can be made.

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