Many Voices Working for the Community

Oak Ridge Site Specific Advisory Board

January 12, 2012

Susan Cange
Acting Assistant Manager for Environmental Management
DOE-Oak Ridge Office
P.O. Box 2001, EM-90
Oak Ridge, TN 37831

Dear Ms. Cange:

Recommendation 208: Recommendation for DOE to Use White Paper on Environmental Management's Challenges on the Oak Ridge Reservation

At our January 11, 2012, meeting the Oak Ridge Site Specific Advisory Board approved the enclosed recommendation suggesting DOE Oak Ridge make use of the white paper, "Balancing Environmental Management Challenges with the Complexity of the Oak Ridge Reservation" in its efforts to secure additional funding for cleanup of the Oak Ridge Reservation.

The white paper lists a number of compelling reasons why the Oak Ridge Reservation has the most complex combination of factors that make it a difficult place to clean up and is deserving of more funding than it has been receiving in recent years.

Please see the enclosed recommendation and accompanying white paper for complete details.

We look forward to receiving your response to this recommendation by March 11, 2012.

Sincerely,

Maggie Owen
Chair, Oak Ridge Site Specific Advisory Board
mo/rsg

Enclosure

cc/enc:
Dave Adler, DOE-ORO
Cate Alexander, DOE-HQ
Fred Butterfield, DOE-HQ
Connie Jones, EPA Region 4
Myron Iwanski, Anderson County Mayor
Melissa Nielson, DOE-HQ
Melyssa Noe, DOE-ORO
John Owsley, TDEC
Mark Watson, Oak Ridge City Manager
Ron Woody, Roane County Executive
File 140.1

Oak Ridge Site Specific Advisory Board Recommendation 208: Recommendation for DOE to Use White Paper on Environmental Management's Challenges on the Oak Ridge Reservation

Background

In the early 1940s, when representatives of the federal government were looking for locations to build facilities for enrichment of uranium and development of the plutonium production and separation processes, they found the area — now known as Oak Ridge — to fit their needs nicely. The area was sparsely populated and remote enough that work could proceed in relative secrecy, yet it was near a large workforce base in Knoxville. In addition, the area was served by rail and there was abundant electrical power for the enrichment facilities. There also was an ample water supply and the topography permitted the three facilities to be constructed in separate valleys, providing a certain amount of protection in case of an accident. These and other factors led eventually to successful enrichment of uranium and development of the plutonium-production technology for nuclear national defense purposes and for civilian power resources.

Over the years, however, this federal property, known today as the Oak Ridge Reservation (ORR), with its three giant facilities (the Y-12 National Security Complex, East Tennessee Technology Center (formerly the K-25 Gaseous Diffusion Plant), and Oak Ridge National Laboratory), became contaminated with a wide variety of radioactive and hazardous waste products. Cleaning up this contamination has become a monumental undertaking beginning in the early 1980s and continuing to the present.

While the Oak Ridge area offered several advantages for the location of the enrichment and processing facilities, noted above, many of these same factors, coupled with high rainfall and complex subsurface conditions, present rather unique challenges for remediation and cleanup of the contaminated areas. These challenges have been recognized for decades by professionals involved in waste management issues on the ORR, but they have had limited publicity through posters and support materials in the community. They have never been summarized and stated in succinct fashion for the non-professional audience and for individuals outside the local community.

Discussion

Because of the diverse waste types, their locations, the diverse technologies applied to remediate them, and their mobility in this humid environment with abundant rainfall and nearby population centers, cleaning up the ORR has been a challenging and expensive undertaking. For several years, the Department of Energy (DOE) Oak Ridge Environmental Management (EM) program received at least $500 million annually for cleanup purposes, an amount that permitted acceptable progress toward this goal. However, that funding level has gradually declined, with the exception of 2009-2011, when one-time American Recovery and Reinvestment Act funding was provided. Funding is not anticipated to increase in the near future beyond baseline levels.

Because of a number of factors outlined in the accompanying white paper, "Balancing Environmental Management Challenges with the Complexity of the Oak Ridge Reservation," future cleanup of the Reservation will continue to face unique challenges not recognized at other DOE facilities across the nation. This unique situation, aggravated by level - or decreasing - budgets, will likely result in hampered progress toward the sophisticated goals that have been established for cleanup of the ORR. This dilemma was openly acknowledged by DOE's Acting Manager of the Oak Ridge Office, John Eschenberg, at the 2011 annual meeting of the Oak Ridge Site Specific Advisory Board (ORSSAB) when he voiced concern about the difficulty in making sufficient progress in light of the complexities of the Reservation under a burden of limited future funding.

Accordingly, the accompanying white paper has been prepared with the intent of providing the Oak Ridge EM program with a "tool" to use in its annual funding requests, as well as a document for informing the public about the unique challenges faced by the Oak Ridge Office. As stated earlier, while these unique challenges have been recognized by technical professionals for many years, this is the first time they have been committed to paper for wide distribution and subsequent use.

Recommendation

ORSSAB offers the white paper, "Balancing Environmental Management Challenges with the Complexity of the Oak Ridge Reservation," for use by DOE. The ORSSAB recommends that it be used in making the case that Oak Ridge has unique technical and environmental challenges that must be taken into consideration during the budgetary discussions establishing funding levels for cleanup activities. In addition, we recommend that the white paper be used, as needed, by DOE in its efforts to keep the public fully informed of the cleanup challenges and progress at Oak Ridge. It will also help inform the public and educate others as to the challenges faced in full-scale remediation of the Reservation.

Balancing Environmental Management Challenges with the Complexity of the Oak Ridge Reservation

Introduction

For years, many have recognized the extreme complexity of the Oak Ridge Reservation (ORR) with regard to environmental management (EM) activities and challenges. The complexity includes a diversity of waste products disposed of and treated in a myriad ways in a setting where there is abundant rainfall and nearby population centers. This situation is further complicated by the highly complex geology of the site and the resulting hydrologic conditions. This document is intended to elucidate aspects of the complexity and to demonstrate this complexity with specific examples and statements. Indeed, the ORR is the most complex of any Department of Energy (DOE) sites with regard to EM activities.

Specific Aspects of the Complexity

1) **Waste Types**. Virtually all types of radioactive and hazardous wastes have been disposed of on the ORR, starting in 1943. At Oak Ridge National Laboratory (ORNL), high-level liquid waste and low-level solid wastes have been generated, characterized by fission products (e.g., strontium-90, cesium-137), uranium, transuranium elements (e.g., plutonium), and decay daughter products (e.g., polonium). In contrast, at Y-12 National Security Complex the dominant waste types include uranium (40 million pounds), mercury (> 2 million pounds), and hazardous organics, often dense non-aqueous phase liquids (DNAPLS) (e.g., carcinogenic trichloroethylene). At East Tennessee Technology Park (formerly known as K-25), wastes include uranium, hexavalent chromium, technetium-99, and a diversity of hazardous organic materials.

   In some instances waste is in storage for later disposal. For instance, about 450 kilograms of uranium-233, now considered to be a waste product, is embedded in two metric tons of uranium and stored in Building 3019 in the central campus of ORNL. Should there be an accidental release of radiation, operations of the lab would be in jeopardy, costing millions in lost work time and decontamination.

2) **Disposal Methods.** A wide variety of disposal methods were employed throughout the ORR over the years; over 6 million curies of activity were disposed of across the ORR. These include shallow-land burial for low-level and uranium wastes (140 acres); engineered landfills for low-level waste; seepage ponds, pits and trenches for liquid wastes (radioactive and organic); direct disposal (diluted) of liquid wastes into the Clinch River; disposal of reactive metals in flooded quarries; and deep well injection (hydrofracture) for highly radioactive liquid wastes. Also, liquid radioactive wastes have been stored for decades in underground tanks for decay of shorter-lived radionuclides; tank wastes were treated in various ways (injection, seepage, etc.) for final disposal. Injected wastes were generally mixed with cement grout and forced under pressure into subsurface strata (hydrofracture), and pits and trenches were filled with liquid wastes, which were allowed to seep into groundwater and ultimately surface water.

3) **Remediation Technologies.** Many technologies have been used to remediate (clean up, immobilize) the disposed wastes. Included are excavation and shipment of wastes to engineered landfills or off site (Waste Isolation Pilot Plant, Nevada National Security Site); compaction and *in situ* immobilization using cement or polyacrylamide grouts; open-atmosphere burning of waste materials in trenches and uranium metal; groundwater diversion systems; *ex situ* bioremediation of groundwaters; land farming; surface impoundments for mercury removal; and *in situ* vitrification (experimental).

4) **ORR Geology.** The ORR is underlain by a complex assemblage of sedimentary rocks (carbonates, sandstone, shale) that have undergone an intense deformation during the formation of the Appalachians. Resulting from this deformation is a series of folded, tilted and faulted strata containing highly developed fracture systems that extend both laterally and to thousands of feet in depth. The geology of the ORR is widely known as the most complex of any DOE site.

5) **Rainfall.** The climate of the ORR area is temperate and humid, with average annual rainfall about 55 inches.

6) **Hydrology**. As a result of the fracture systems, high rainfall, noted above, and karst development, the hydrology is exceptionally complex. Most groundwater flow is controlled by the fracture systems, which are exceedingly difficult to understand and predict as pathways for groundwater and waste movement; conventional mathematical modeling of these transport mechanisms is not applicable here. In addition, carbonate units are often characterized by solution development (karst) where groundwater can rapidly flow great distances. There is close interaction between surface water and groundwater, and contaminants carried by groundwater generally end up in the surface water, principally the Clinch River, which flows to the southwest into the Tennessee River.

7) **Population Centers.** Because of the interaction of surface water and groundwater, special attention must be given to the water usage in communities downstream from the ORR. In fact, the population density in the immediate vicinity of the ORR is higher than any other DOE site in the complex. The population in the counties immediately surrounding Oak Ridge is more than 815,000 people.

   For instance, communities like Kingston, Rockwood, Dayton, Spring City, and as far as Chattanooga draw water supplied from the Clinch and Tennessee Rivers (fortunately most insoluble contaminants in the river systems are covered by "clean" sediment, but the possibility persists that this could be upset by man-induced or natural causes). The City of Oak Ridge lies adjacent to the Y-12 National Security Complex, and surface drainage from Y-12 in the Poplar Creek system that flows through Oak Ridge carries potentially dangerous amounts of mercury; the creek is posted for this reason. To the northeast of Y-12, off the ORR, groundwater is contaminated with carcinogenic organic chemicals; private drilling for groundwater in this commercial area is prohibited. Although unconfirmed at present, the possibility exists that there may be affected rural areas southwest of ORNL across the Clinch River where contaminants may have spread in the groundwater.

<u>Overview</u>

The information presented above demonstrates the extreme complexity of the ORR with respect to EM activities. Many more examples can be cited, but it is hoped that the reader will agree with the fundamental tenet of this short statement, based on the information presented. No attempt is made herein to compare the ORR to other DOE facilities, each of which has its own set of complexities and challenges. Other sites *do* demonstrate complexity of one or more of these aspects (e.g., Hanford has fracture flow in its bedrock and large amounts of liquid high-level waste, but it has sparse rainfall and is remote with respect to large population centers; the Savannah River Site has relatively close smaller population centers, but lacks the diversity of waste types and disposal methods). In no case, however, does any other DOE site display the spectrum of characteristics described here for the ORR.

Indeed, it can be stated that the complexity of the ORR from a variety of factors, related to EM interests, is the greatest of any DOE site.