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Cold War Legacy Not A Post-Dismantlement Environmental Concern

—by Emitt C. Witt, III

Background

Standing ready to defend our country or to assure mutual destruction, the mid-west's contribution to nuclear proliferation of the 60s and 70s resided innocuously beneath concrete slabs in Missouri's cornfields. In June 1961, the U.S. Department of Defense (DOD) implemented a plan to place 150 intercontinental ballistic missiles in west-central Missouri (fig. 1). The missile was the solid propellant Minuteman series rocket capable of accurately delivering three nuclear warheads to targets halfway around the world. Cold war tensions at the time necessitated quick deployment of this national defense system. Construction of the missile launch facilities in Missouri began in April 1962 and within 26 months the entire system was completed and on full-alert status.

Minuteman I missiles originally deployed were replaced by the more modern Minuteman II missiles beginning in May 1966. By October 1972 all Minuteman II missiles were in place and on full-alert status. Few changes to the missile system were made until the stand-down order was issued from President George Bush on September 27, 1991, directing the U.S. Air Force to begin dismantlement of the missiles and launch facilities. The stand-down order came following the historical signing of the Strategic Arms Reduction Treaty (START) by the United States and Russia.

Missile Launch Facilities

In April 1961, Missouri was chosen as an area for Minuteman missile deployment after extensive geologic surveys and testing by DOD contractors, the U.S. Army Corps of Engineers, and the U.S. Geological Survey. Launch facilities were designed to withstand a direct hit by opposing nuclear missiles. To harden these for potential nuclear attack, launch facilities were fabricated of concrete and 2-inch reinforcement bar and installed below land surface. Launch tubes were constructed to a depth of 80 feet with a 4-foot thick concrete base containing a sump to collect any ground water that might enter the facility. The missile control room was constructed adjacent to the launch tube to a depth of 33 feet. The control room contained a diesel-powered electric generator, batteries, controlling equipment, and a 14,500-gallon diesel fuel storage tank. The control room and all metal surfaces were coated with a waterproof coating containing polychlorinated biphenyls (PCBs) to prevent corrosion.

Historic photograph of Minuteman II construction. Courtesy of Whiteman Air Force Base, Oscar I Museum, 1962.

Implosion of missile launch facility. Courtesy of Whiteman Air Force Base, 1995.

Dismantlement of Launch Facilities

Dismantlement of the launch facilities began on December 8, 1993, with implosion of the first launch control room and the upper part of the launch tube. Debris from the implosion was pushed into the remaining unaffected lower part of the tube and covered with concrete. Following a 90-day observation period as mandated by START, the site was covered with an impermeable material and backfilled to grade with gravel and native soil. All known contaminated soil was removed from the site before closure. This process was officially complete at all 150 launch facilities by September 1998.

Contaminants of Concern

Government facilities do not close without first examining the effects of it’s past and current activities. The PCB water-proofing materials used to coat these upper launch facilities, and constituents of diesel fuel were identified as contaminants of concern by a pre-dismantlement environmental assessment (Labat-Anderson, Inc., 1992; SEC Donohue, 1992). Although PCBs are relatively immobile polar molecules in soil environments, their mobility may be increased if dissolved within a solvent such as diesel fuel. The possibility of diesel fuel contaminated with PCB compounds entering the ground water posed a potential threat to human health and the environment.

Federal Facility Compliance Agreement

A Federal Facility Compliance Agreement (FFCA) outlines the environmental expectations of the U.S. Environmental Protection Agency and the Missouri Department of Natural Resources for closure of any federal facility that has potential environmental hazards.

The FFCA in place for the dismantled missile deployment area requires that long-term ground-water monitoring be conducted at each facility at which there was determined to be present a leaking underground fuel storage tank, where PCB compounds are present in ground water at a concentration greater than 0.5 µg/L (microgram per liter), where a drinking water-supply well is present hydraulically downgradient from a facility within 0.25 mile, and for at least one representative facility per local geologic setting. The FFCA required the U.S. Air Force to initiate this ground-water monitoring strategy by June 22, 1997.

Long-Term Monitoring Network

An extensive environmental survey as well as an interim ground-water sampling effort was conducted within the missile deployment area by the U.S. Geological Survey (E.C.

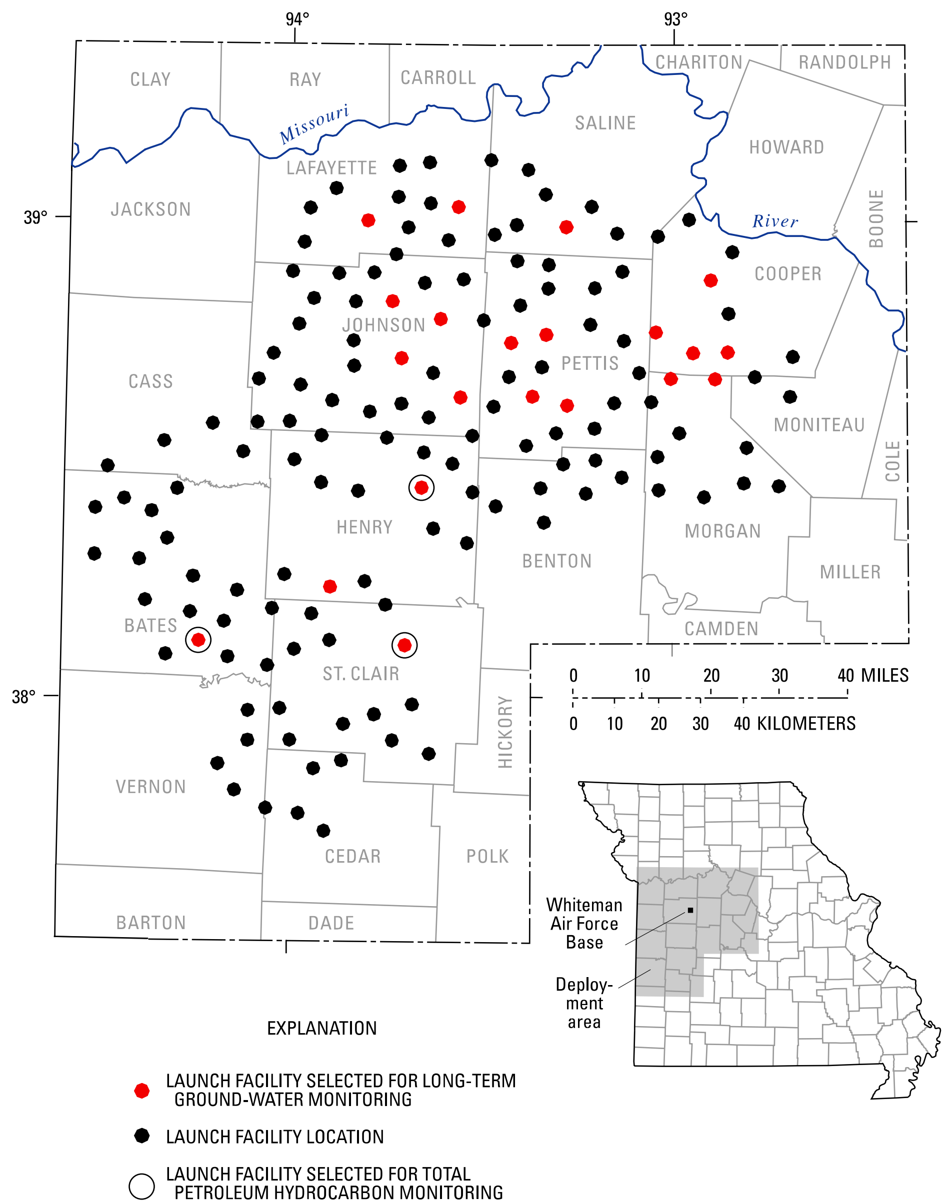

Figure 1. Minuteman II Missile deployment area showing location of the launch facilities selected for long-term ground-water monitoring, west-central Missouri.

Witt and others, U.S. Geological Survey, written commun., 1995) to identify feasible locations of monitoring wells where long-term monitoring should be conducted to meet the requirements of the FFCA. Twenty-one launch facilities were selected, and 101 monitoring wells were installed around former launch tube areas in shallow and deep pairs at depths of 45 and 100 feet. All monitoring wells were constructed according to Missouri State Regulation MO 10 CSR 23-4. Dedicated stainless-steel/Teflon bladder pumps were installed for withdrawing ground-water samples for chemical analysis. Samples were collected once per year for the analysis of PCBs at all monitoring wells beginning in 1997. Concentration for total petroleum hydrocarbons (TPH); diesel range organic compounds (DRO); gasoline range organic compounds (GRO); benzene, toluene, ethylene, and xylene (BTEX) were determined for ground-water samples collected at three former launch facilities characterized by evidence of diesel fuel leakage (fig. 1). Three of the wells in the long-term monitoring network did not produce sufficient water to sample. The FFCA requires monitoring for 5 years.

Sample Collection

Water samples were collected at each monitoring well using U.S. Geological Survey ground-water data collection techniques (Hardy and others, 1989; Koterba and others, 1995; Koterba, 1998; Lapham and others, 1995). A Quality Assurance Project Plan was developed and approved before the beginning of sampling (D.N. Mugel and E.C. Witt, U.S. Geological Survey, written commun., 1996). Ground-water samples were withdrawn from wells using bladder pumps dedicated within each well for the duration of the monitoring period. Approximately three well volumes of water were removed before sample collection in an effort to obtain a representative sample of water from the surrounding aquifer. Analysis was conducted on whole-water (unfiltered) to assure PCB compounds attached to sediment would be available for detection. Measurements of specific conductance, pH, and temperature were recorded during the sampling procedure (Wilde and Radtke, 1998). Water levels were recorded in the monitoring wells before, during, and after the sample collection.

Samples were processed onsite for shipment to the analytical laboratory within minutes of collection. All samples were shipped to the laboratory accompanied by required chain-of-custody documentation using an overnight contract carrier.

Monitoring Results

Results of the 392 samples submitted to the laboratory for analysis indicated that concentrations of PCB compounds did not exceed the analytical minimum reporting level (MRL) of 0.5 µg/L. Results of analysis of water in 18 field blanks, 7 trip blanks, and 1 equipment blank analyzed for PCB compounds indicate no error affecting constituent concentration in samples was introduced by

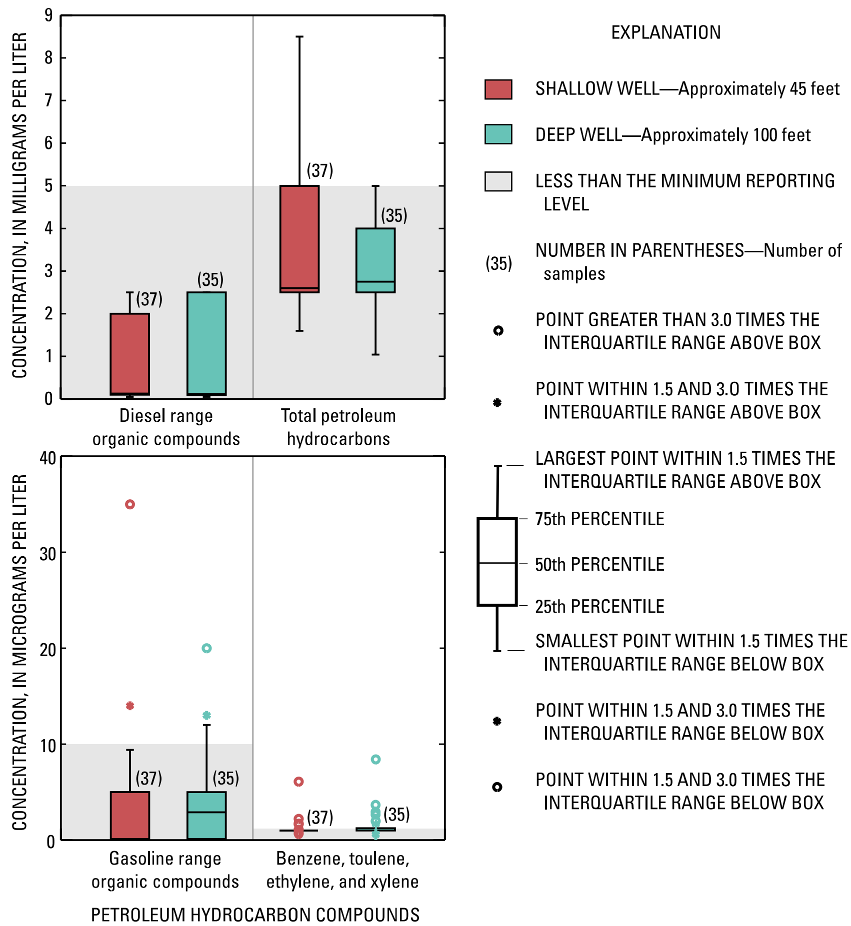

Figure 2. Range of petroleum hydrocarbon results for 18 wells in the long-term monitoring network.

sampling and handling processes. The PCB concentrations were lower than the action level defined in the FFCA. There is no evidence of PCB contamination in the local ground-water resource in the data collected during the 4-year monitoring period.

Ground-water samples from 9 shallow (45 feet) and 9 deep (100 feet) wells were collected from three dismantled launch facilities and analyzed for concentration of TPH. Concentrations of TPH ranged from below the MRL of 5.0 µg/L to 8.5 µg/L (fig. 2). One of 72 samples had a concentration exceeding the MRL. This sample was collected from one of the 9 shallow wells. Twenty ground-water samples had estimated concentrations less than the MRL, and the remaining 51 samples were reported as less than the MRL. No deep well had a concentration greater than the MRL; however, 15 of the 20 estimated concentrations below the MRL were found in these monitoring wells.

Petroleum hydrocarbon analysis was further broken down into specific carbon chain analyses (DRO and GRO) that represent specific classes of fuel. These analyses were used to identify the specific contaminant. The DROs were not detected at concentrations larger than the MRL of 5.0 µg/L, but estimated concentrations less than the MRL were detected in 21 of 80 samples analyzed. These estimated concentrations ranged from 0.061 µg/L to 2.3 µg/L.

The GROs were detected at concentrations larger than the MRL in 23 of 72 samples collected during the monitoring period. The GRO concentrations ranged from less than the lowest MRL of 0.1 µg/L to 35 µg/L. Analytical MRLs ranged from 0.1 µg/L to 10 µg/L (fig. 2) depending on laboratory standards and quality assurance methods at the time of analysis.

The BTEX compounds were detected in samples from all wells with detectable concentrations of GRO. Concentrations of BTEX compounds ranged from less than the MRL of 0.5 µg/L to 4.0 µg/L (fig. 2). The MRL was exceeded in 18 of 72 samples. Estimated concentrations at less than the MRL were detected in 23 samples. The largest concentrations of BTEX compounds detected were for toluene and xylene.

At no time during 4 years of monitoring were PCBs detected in the ground water. Petroleum hydrocarbons were detected in ground water in small concentrations at one dismantled launch facility. Ground-water monitoring in the well network will continue under the guidelines of the FFCA until September 30, 2002. At the completion of the 5-year monitoring period, the U.S. Air Force and the Missouri Department of Natural Resources will examine the need for additional monitoring.

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