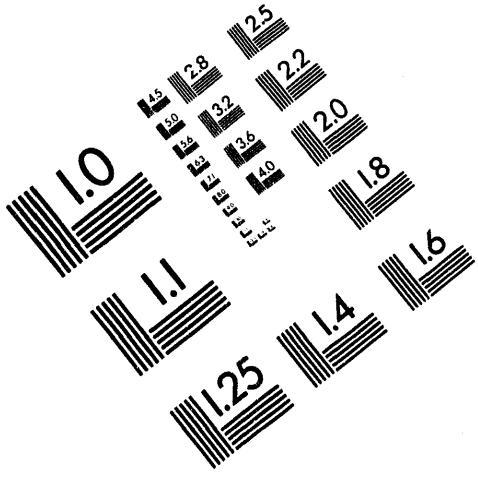

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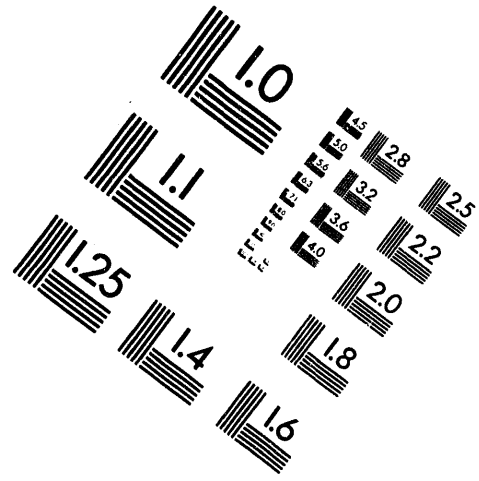

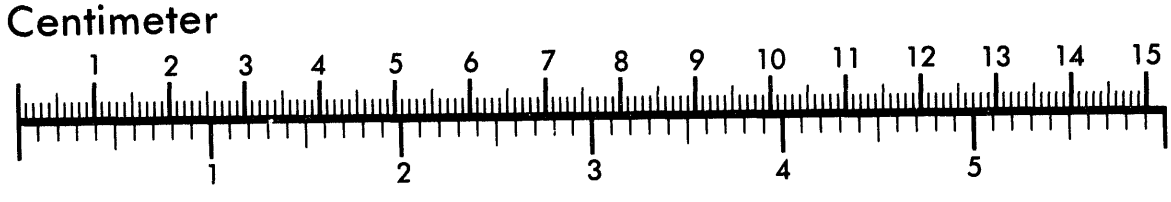

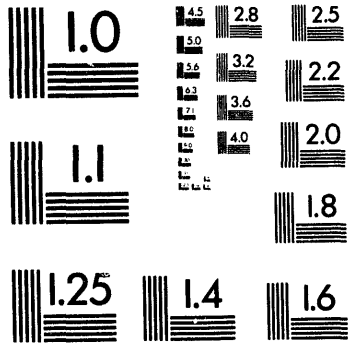

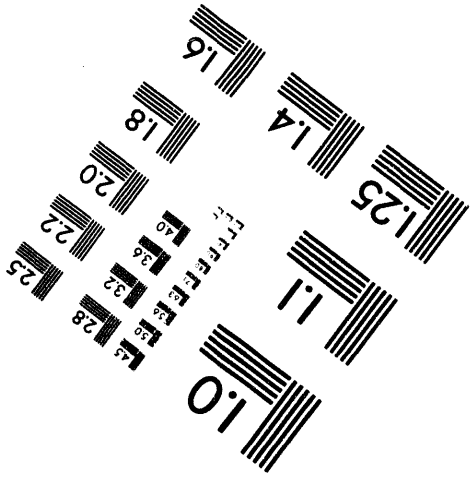

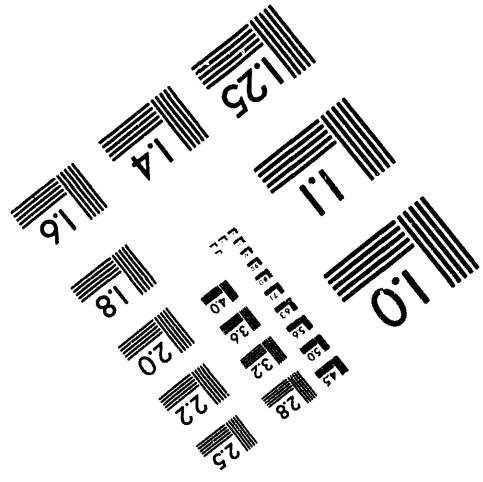

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Dismantlement and Demilitarization

Demilitarization and Treatment of Energetic Materials and Componentry

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Technology development for the demilitarization and treatment of energetic material and componentry was initiated by Sandia in 1991. We have been investigating commercial technologies and performing development activities. Currently, we have programs performing demilitarization of energetic components in a plasma arc facility and technology development for destruction of hazardous materials using supercritical water oxidation (SCWO).

Sandia began investigating the demilitarization of small energetic components in 1993. We evaluated several technologies including: incineration in a rotary kiln, molten metal treatment, multiple process treatment such as cryogenic crushing followed by base hydrolysis, and plasma arc processing. After considering regulatory permitting, preprocessing burdens, secondary waste streams, and safety, plasma arc processing was selected.

The plasma energy system is engineered around the use of a plasma arc torch to provide the high temperatures needed for thermal demilitarization of the components. The torch generates partially ionized plasmas that produce temperatures between 3,000 and 12,000 degrees Fahrenheit. Gas enthalpy is the main factor in determining suitable applications of this type of plasma, such as for the destruction of wastes including organic chemical compounds, munitions residues, and components.

All components fed into the system are pyrolyzed compounds are reduced to a product gas consisting mainly of H_2, CO, some CO_2, and lower order aliphatics. Oxygen needed to bond to carbon is provided by steam injection so that this system can be considered a plasma driven, steam reforming reactor. Inorganic compounds melt into silica (SiO_2) and form a glassy slag mineral material. For waste streams high in precious and non base metals (copper and higher in the electromotive series), precious metals can be scavenged by copper and lead and recovered as ingots.

In the past year, surrogate materials in the form of black powder and primaries have been processed as well as whole small energetic components in the form of thermal batteries, detonators, ignitors, and gas generators. Chamber pressure, emissions, metal and slag residues were measured for safety, regulatory requirements, and leachability testing. The test results to date are positive.

Supercritical water oxidation (SCWO) is a rapidly evolving, hazardous waste treatment technology that has attracted the interest of both private industry and government agencies including the Department of Defense (DoD) and the Department of Energy (DOE). Government agencies are currently funding projects investigating the use of SCWO technology for destruction of smoke, dye, and pyrotechnic munitions, destruction of chemical warfare agents and obsolete rocket boosters, pretreatment of DOE Hanford mixed wastes, and destruction of the organic part of DOE Idaho National Engineering Laboratory (INEL) mixed wastes.

Sandia/California has designed and built two bench-scale SCWO reactors that are modular, ten to twenty gallons per day capacity, and of tubular design. The first reactor, the Materials Evaluation Reactor (MER), has been operating since 1991. The MER is located in Sandia's Combustion Research Facility and features laser instrumentation for *in situ* characterization of the SCWO reaction. Additional off-line effluent monitoring and analyses are also available. The second reactor, the Engineering Evaluation Reactor (EER), is remotely operated with a computer control system and is located in an explosive-qualified test cell. Both reactors are design to operate up to 7500 psi and 650°C, well above typical SCWO conditions. The reactors are used to evaluate the destruction of various wastes from pesticides and solvents to obsolete military smokes, dyes, and pyrotechnics.

The U.S. Army Armament Research, Development, and Engineering Center at Picatinny Arsenal, NJ is funding the development of SCWO for disposing of obsolete munitions such as colored spotting dyes and a wide assortment of pyrotechnics including colored smokes and flares. In 1980, the Surgeon General's office banned the open burning of colored smoke, dye, and pyrotechnic munitions. The feasibility of SCWO for processing these materials was demonstrated in one of Sandia's bench reactors. Four colored dyes and one pyrotechnic smoke composition were processed and the effluent was analyzed for effectiveness of the processing. The tests showed that all of these materials could be oxidized to much less hazardous compounds in less than ten seconds with destruction and removal efficiency greater than 99.5%. Several technical issues were identified for further study: formation of sulfate and chloride salt, deposition of these salts within the flow reactor, and corrosion of the reactor. This project will culminate in the construction of a SCWO pilot plant at McAlester Army Ammunition Plant for destruction of these wastes.

Sandia's other SCWO projects include an experimental feasibility study of Explosive D (ammonium picrate) for the Naval Surface Weapons Center, salt deposition studies and *in situ* optical diagnostic for chemical kinetics for the Advanced Research Projects Agency (formerly DARPA), experimental feasibility studies of industrial wastes and fundamental studies of diffusion flames in supercritical water/fuel/oxygen mixtures for the Naval Civil Engineering Laboratory; SCWO kinetics modeling and transpiration-cooled reactor testing for mixed waste treatment for the DOE Office of Environmental Restoration and Waste Management; and fundamental understanding of reactor kinetics for the Strategic Environmental Research and Development Program.

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