

CRADLE TO GRAVE

A waterblasting system operating at 10,000 to 15,000 psi helps the U.S. Air Force Research Laboratory recycle munitions

By **Scottie Dayton**

The Air Force Research Laboratory (AFRL), Eglin Air Force Base, Fla., develops new weapons systems and explosives. Expensive, experimental, prototype warheads arrive at the Ordnance Division to receive plastic-bonded explosives (PBX). Once loaded, the bombs are x-rayed for voids or an imperfect charge. Before 1995, flawed warheads were burned in a molten salt reactor or taken to the demolition range and open burned or detonated.

When the military's munitions recycling program began in 1995, AFRL adopted a cradle-to-grave policy in which planning for disposal of a warhead was

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Bill Harrison

part of its development process. "We needed environmentally friendlier technology that allowed us to recover these one-of-a-kind bombs," says Bill Harrison, a Civil Service engineering technician. Recovering the warheads is the reclamation program's prime objective.

Harrison and the Ordnance Division researched what was available in the industry and talked to other military branches that used high-pressure water washout to reclaim nitramines from



Inside a macerator, high-pressure waterjets break down warhead material.

melt/cast and plastic-bonded explosives.

In 1997, the Air Force contracted Ease Engineering of Salt Lake City, Utah, to provide the washout system. That company subcontracted with Setpoint Engineered Systems Inc. of Ogden, Utah, for the industrial automation controls. Harrison and the Ordnance

Division helped design and install the equipment to the Air Force's special requirements.

Demilitarizing bombs

The two-stage reclamation process occurs inside a cinder block building. The two operators stand 1,000 feet away behind a concrete wall during washout. Warheads weighing 250 to 2,000 pounds — basically half that weight is explosives — lie on a tilt table.

A stainless steel drum containing the hydromining equipment encompasses the base of the warhead. A single multi-jet nozzle from Aqua-Dyne Inc. with three-axis control and rotary coupling is mounted on a stainless steel lance. "The three-axis control allows us to program the nozzle to go around the conduits and piping inside the warheads," says Harrison.

Aqua-Dyne service engineer Wayne Griffin, helped modify the company's Dyna valve. "We put an electric actuator on it to vary the pressure and flow output from an Aqua-Dyne GA 150 hp, horizontal triplex positive displacement pump," says Harrison.

The lance has a 17- by 17- by 112-inch operational range, a 1 to 400 inch per minute (ipm) linear cut speed, and a 600 ipm rapid traverse speed. A ViT Media miniature video camera from Bournemouth, U.K., observes the hydromining operation and inspects the casing's interior. The lance and camera are inside a carbon composite sleeve within the drum.

After the table is raised 20 degrees, hydromining occurs at 10,000 to 15,000 psi and 8 to 14 gpm. The explosive fill comes out in chunks, gravity-feeds into a stainless steel shroud, runs out a pipe at the bottom of the shroud, and enters a macerator. When the macerator's 50-pound limit is reached, a diverter valve switches the high-pressure water from the jet nozzle to the macerator.

Inside the macerator's lid are six Aqua-Dyne ShapeJet nozzles on a rotating spray bar, operating at 10,000 to 11,000 psi and 15 gpm. The spray bar works with a vibrator that shakes the material through various-sized screens, reducing the PBX to 1/8-inch particles. Matter is then diverted out the left side of the macerator and into one of two 50-gallon tanks, the first with a load sill. After a fixed amount of PBX is processed, water is added and the slurry —



A research technician at Eglin Air Force Base prepares to demilitarize a warhead through hydro-mining with high-pressure waterblasting equipment supplied by Aqua-Dyne Inc.

one-third PBX and two-thirds water — is transferred temporarily to a stirred holding tank.

The water from the macerator is channeled to one of two 50-gallon settling tanks containing sand filters, 10-micron pleated paper filters, and activated carbon filters. After treatment, the water is pumped back through the closed-loop system to the 2,000-gallon holding tank that feeds the waterjetting pump.

"We can't wash and macerate at the same time, because we have only one pump," says Harrison. "It takes half a day to demilitarize a 250-pound warhead, and one to one-and-a-half days to process a 2,000-pound warhead. We dispose of the PBX in an open-burn or detonate it on the range."

All operations are computer controlled through a man-machine interface (MMI) that communicates with the programmable logic controllers. The system uses Rockwell RS View software and Allen-Bradley programmable controllers.

TOUGH JOB

PROJECT:

Recover munitions hardware and explosive fills

CONTRACTOR:

Munitions Directorate, Ordnance Division, Energetic Materials Branch, Eglin, Fla.

CUSTOMER:

Eglin Air Force Base, Eglin, Fla.

EQUIPMENT SUPPLIER:

Aqua-Dyne Inc., Houston, Tex.

Maintenance

"Aqua-Dyne's equipment is working very well in a tough environment," said Harrison. "We have corrosive leaching into the recycled water and the resulting high pH pits the steel nozzles. Consequently, we replace them after every second warhead. We also rebuild the Dyna valve regularly." The entire system undergoes monthly routine maintenance.

EDITOR'S NOTE: The macerator and molten salt reactor were transferred recently to the McAlester Army Ammunition Plant in McAlester, Okla. ■