14th

Global Demil Symposium & Exhibition

1-4 May 2006

Indianapolis Convention Center

Indianapolis, Indiana

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Preface

The 14th annual symposium was held on 1-5 May 2006 in Indianapolis, IN. The symposium featured more than 400 participants representing 11 countries; with 36 exhibits, and 82 formal presentations on policy, execution, and RDT&E for conventional, tactical, chemical and strategic munitions demil. Mr. Randall Burcham, Crane Army Ammunition Activity (CAAA), Lead Demil Engineer, was presented the 12th John L. Byrd, Jr. Award for Excellence in Munitions Demilitarization for his efforts in innovative demilitarization operations. BG James Rogers, CG, JMC, delivered the keynote address, addressing the complementary roles we play in the war on terror and the spread of democracy. Ms. Shannon Cunniff, Office of Secretary of Defense, Special Assistant for Emerging Contaminants, presented an OSD "Chemicals of Concern" perspective. LTC Brian Raftery, PM Demilitarization; Mr. Lou Ligeno, JMC; and Mr. Larry Gunter presented additional details on recent demil successes; while Mr. Ralph Hayes, El Dorado Engineering, and Mr. Wilfried Meyer, General Dynamics OTS, presented industry initiatives. COL Ki-Soo Lee, Korean Ministry of Defense, presented the status of the Joint US-ROK Demil Facility (DEFAC). Mr. Peter Courtney-Green, NATO Maintenance and Supply Agency (NAMSA), provided an international perspective, and Mr. Keith Angles, Huntsville COE, presented a coalition munitions clearance (CMC) update. Numerous other operational/R&D program reviews, and environmental and demil related breakout meetings. Volume 19 of the JOCG Demil Express was distributed during the conference.

COL Todd Smith, Commander CAAA, and the Crane Division Naval Surface Warfare Center, hosted tours of CAAA demilitarization execution operations and Navy R&D initiatives on 5 May, with nearly 120 meeting participants.

The Joint Ordnance Commanders Group (JOCG) and the National Defense Industrial Association (NDIA) would like to thank everyone for their participation at this event.

Demil Users Group Meeting

15th Annual Demil Users Group Meeting

17-18 October 2006

The Riviera Hotel and Casino

Las Vegas, Nevada

For room reservations call 1-800-634-6753

To register contact:
Nick Smith
Demil Users Group Coordinator
918-420-8139
robert.n.smith@us.army.mil
Defense Ammunition Center
BLDG 35 DAC-TD
1 C-Tree RD.
McAlester, OK 74501

IMPORTANT DATES:

24 Jul 06 – Call for papers/abstracts

14 Aug 06 – Deadline for abstracts

28 Aug 06 – Final Agenda published

2007

GLOBAL DEMILITARIZATION SYMPOSIUM AND EXHIBITION

14-17 May 2007
The Hilton
Reno, NV

Important Dates:

29 Nov 06 - ***Call for papers is distributed by NDIA to announce the Symposium***

11 Jan 07 - ***Deadline for Abstracts***

26 Feb 07 - ***Program Agenda Released***

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION

For Room Reservations Call 1-800-648-5080 Request group rate for "2007 Demil Conference"

Mr. Kenneth Adkins
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
kenneth.d.adkins@us.army.mil
(918)420-8236

Mr. Timothy Alexander
Army Environmental Center
5179 Hoadley Road, Bldg 4480
Apg-Ea MD 21010
timothy.a.alexander@us.army.mil
(410)436-1613

CW2 Kiwon Anderson
Ft. Irwin Ammunition Supply Point
ASP Road
Bldg. 7600
Ft. Irwin CA 92310
kiwon.anderson@us.army.mil
(760)380-4251

Mr. Robert Anderson
Tooele Army Depot
1 Tooele Army Depot
Bldg 1046
Tooele UT 84074-5003
robert.anderson@us.army.mil
(435)833-5071

Mr. Walter Angles
U.S. Army Corps of Engineer,
Huntsville Center
4820 University Square
2K402
Huntsville AL 35817
Walter.Angles@hnd01.usace.army.mil
(256)895-1324

Mr. Eddie Ansell
Defense Ammunition Center
1 C-Tree Rd
Bldg 35
McAlester OK 74501-9053
ed.ansell@dac.army.mil
(918)420-8081

Mr. Joseph Asahina
Kobe Steel Ltd
2-7 4-Chome
Iwayanakachi, Nada-Ku
Kobe 657-0845
JAPAN
k.kasahina@engnet.kobelco.co.jp
81782617042

Ms. Maureen Audley
Applied Ordnance Technology, Inc.
4473 Indian Head Hwy
Indian Head MD 20640
maudley@aot.com
(301)753-5600

Mr. Bart Barthold
NDCEE
100 CTC Dr
Johnstown PA 15904
barthlof@ctc.com
(812)825-2390

Ms. Elizabeth Bartlett
U.S. EPA
61 Forsyth St SW
MC 4WD-RPB
Atlanta GA 30303
barlett.eliizabeth@epa.gov
(404)562-8435

Mr. Glenn Beach
Cybernet Systems Corporation
727 Airport Blvd.
Ann Arbor MI 48108
gbeach@cybernet.com
(734)668-2567

Mr. Howard Beardsley
Booz Allen Hamilton
4692 Millennium Dr
Belcamp MD 21017-1535
beardsley_howard@bah.com
(410)297-2528

Miss Jean Bergeron
Directorate Armament Sustainment
101 Colonel By Dr
MGen Pearkes Bldg.
Ottawa ON K1A 0K2
CANADA
bergeron.gaj@forces.gc.co
(819)994-9492

Dr. Hans Beutelman
Tybrin Corporation
307 E Popson Ave
Bldg 1400
Edwards AFB CA 93524-6600
hans.beutelman.ctr@edwards.af.mil
(661)277-2177

Mr. John Bezner
Lockheed Martin Missiles and Fire
Control
P.O. Box 65003
MS:MC-50
Dallas TX 75265-0003
john.bezner@lmco.com
(972)603-2640

Mr. Randel Bigelow Jr.
Defense Ammunition Center
1 C Tree Rd
Bldg. 35
McAlester OK 74501
randy.bigelow@us.army.mil
(918)420-8485

Mr. Steve Biles
Bouldin & Lawson, LLC
PO Box 7177
McMinnville TN 37111
sbiles@bouldinlawson.com
(931)668-4090

Mr. D. Brint Bixler
CH2M Hill
13921 Park Center Road
Suite 600
Herndon VA 20171-3241
bbixler@ch2m.com
(703)471-1441

Mr. David Bluford
ATK Thiokol
P.O. Box 707
Brigham City UT 84301-0707
david.bluford@atk.com
(435)863-6174

Ms. Cindy Bogue
Blue Grass Army Depot
2091 Kingston Hwy
Richmond KY 40475-5105
cindy.bogue@us.army.mil
(859)779-6469

Ms. Lois Bohne
Naval Ordnance Safety Security Activity
23 Strauss Ave
Farragut Hall Building D-323
Indian Head MD 20640-1541
bohnels@ih.navy.mil
(301)744-4906

Mr. Terry Bone
75 CEG/CEU
7302 Wardleigh Road
Bldg. #15
Hill AFB UT 84056
terry.bone@hill.af.mil
(801)777-1539

Dr. Renato Bonora
University od Padua Italy Dept. of Industrial Chemical Processes
Renato Bonora
Dipartimento di Processi Chimici dell'Ingegneria
Via Marzolo, 9
Padova 35131
ITALY
renato.bonora@unipd.it

Mr. Steven Bormet
Argonne National Laboratory
9700 S. Cass Avenue
Suite 900
Argonne IL 60439
smbormet@anl.gov
(630)252-7675

Mr. William Bovenschen
Science Applications International Corporation
RR 6 Box 28
Highway 231 South
Bloomfield IN 47424
bovenschenw@us-bloomfield.mail.saic.com
(812)384-3587

Mr. James Bowie
U.S. Army College
HQ's CFC C4, Youngsan Seoul
APO AP 17013
bowiejf@aol.com
(717)243-3124

Mr. James Bracey
OO-ALC/WMCI
6043 Elm Lane
Bldg 1246
Hill AFB UT 84056-5819
james.bracey@hill.af.mil
(801)775-3065

Mr. Reijo Bragberg
Nammo Demil Division
Vingåkersverken
Vingåker 64392
SWEEDEN
reijo.bragberg@nammo.com
+46 151 19518

Mr. Jay Brannam
ASA (ALT)
5804 Hall St
Burke VA 22015
jay.brannam@us.army.mil
(703)604-7221

Ms. Stacy Braye
USEPA
75 Hawthorne Street
WST-4
San Francisco CA 94105
braye.stacy@epa.gov
(415)972-3345

Mr. Richard Brewster
Ellwood National Forge Company
1 Front St.
Irvine PA 16329-1801
rbrewster@elwd.com
(814)563-8727

Mr. Matthew Brogneri
U.S. Army ARDEC
Attn: AMSRD-AAR-AIL-LA
Picatinny NJ 07806
mbrogn@pica.army.mil
(973)724-1557

Ms. Sheila Brown
QuantiTech, Inc.
300 Voyager Way
Huntsville AL 35806
Sheila.Brown@quantitech.com
(256)650-6263 Ext. 206

Mr. Stephen Brownrigg
National Defense of Canada
182 Palomino Dr
Kanata ON K2M 1P2
CANADA
brownrigg.sp@forces.gc.ca
(819)994-2411

Mr. Paul Bryan
Day & Zimmermann, Inc.
23018 Rooks Rd.
Suite A
Parsons KS 67357-8403
paul.bryan@dzikansas.com
(620)421-7473

Mr. David Burbank
ATK Thiokol
P.O. Box 707
Brigham City UT 84301-0707
david.burbank@atk.com
(435)863-2363

Mr. Dan Burch
NSWC, Crane Division
300 Highway 361
Code 4073, Bldg 2540
Crane IN 47522
danny.burch@navy.mil
(812)854-3505

Mr. Randall Burcham
Crane Army Ammunition Activity
SJMCN-MEE
Crane IN 47522-5099
randall.burcham@us.army.mil
(812)854-1353

Mrs. Shania Burrows
Aviation and Missile Life Cycle
Managment Command G-3
Operations
Bldg 5308 Sparkman Circle
Huntsville AL 35898
shania.burrows@us.army.mil
(256)876-6156

Mr. Charles Burton
AMTEC
500 Wynn Dr Nw
Suite 314
Huntsville AL 35816-3462
hburton@amtec-corp.com
(256)759-2918

Mr. Jim Carr
QinetiQ
New Ranges
Shoeburyness
Southend on Sea
UNITED KINGDOM
jmcarr@qinetiq.com
0044170238

Mr. Tom Carr
Camber Corporation
255 Borelli Rd
New Market AL 35761-9416
tcarr@camber.com
(256)379-4304

Mr. Vahik Chamras
Oklahoma State University
145 Phyics Sciences
Stillwater OK 74078
v.chamras@okstate.edu
(405)744-7982

Mr. Carl Christiansen
EASE, Inc.
211 East Broadway
Suite 204
Salt Lake City UT 84111
ease@xmission.com
(801)539-0100

Dr. Kyong Chun
Argonne National Laboratory
955 L'Enfant Plaza, Sw
Suite 6000
Washington DC 20024-2112
kcchun@anl.gov
(202)488-2435

Ms. Wendy Church
PIKA International, inc.
12919 Southwest Freeway
Stafford TX 77477
wchurch@pikainc.com
(281)340-5525

Mr. Clifford Cichowlaz
Day & Zimmermann, Inc.
2 South Maine
Building #2
Hawthorne NV 89415
clifford.cichowlaz@dzhc.com
(775)945-7660

Dr. Kerry Clark
NSWC, Indian Head Division
101 Strauss Ave
Bldg. 1864
Indian Head MD 20640
kerry.a.clark@navy.mil
(301)744-4102

Mr. Keith Clift
Defense Ammunition Center
1 C Tree Rd (Attn: Sjmac-Tdr)
Bldg 35
McAlester OK 74501
keith.clift@dac.army.mil
(918)420-8084

Mr. David Collins
DGM IPT
Spur 9, Crescent Block
Ensleigh Site
Bath BA1 5AB
UNITED KINGDOM
david.collins360@mod.uk
441225467919

Dr. Thomas Collins
Oklahoma State University/CIED
310 WWC
OK. State University
Stillwater OK 74078
thomas.collins@okstate.edu
(405)744-2468

Mr. Justin Conklin
U.S. Army ARDEC
Attn: AMSRD-AAR-AIL-LA
Picatinny Arsenal NJ 07806
justin.conklin1@pica.army.mil
(973)724-3475

Ms Melinda Cook
McAlester Army Ammunition Plant
SJMMC-LOS
1 C Tree Rd.
McAlester OK 74501
melinda.cook@mcaap.army.mil
(918)420-7312

Mr. Edward Coppola
Applied Research Associates
430 West 5th Street
Suite 700
Panama City FL 32401
ecoppola@ara.com
(850)914-3188

Mr. James Cornell
ATK Thiokol
P.O. Box 707
Brigham City UT 84301-0707
james.cornell@atk.com
(435)863-3953

Mr. Julian Cothran
Precision Fires Rocket & Missile System
5250 Martin Rd
SFAE-MSLS-TM
Redstone Arsenal AL 35898
bev.overman@us.army.mil
(256)876-5230

Mr. Peter Courtney-Green
NATO Maintenance & Supply Agency
13, Rue De La Gare
Capellen 3302
LUXEMBOURG
pcourtney-green@namsa.nato.int
352 3063 6447

Mr. Matt Coverdale
Premier Technology, Inc.
170 E. Siphon Rd.
Pocatello ID 83202
mcoverdale@premiertechnology.cc
(208)760-9193

Mr. Randall Cramer
NSWC, Indian Head Division
101 Strauss Ave.
Indian Head MD 20640
randall.cramer@navy.mil
(301)744-4279

Mr. George Crandell
Technikon
5301 Price Ave
Mcclellan CA 95652-2401
gcrandell@technikonllc.com
(916)929-8001

Mr. Jim Creekmore
Clean Harbors Environmental Services
200 Arbor Lake Dr
Columbia SC 29223
creekmore.james@cleanharbors.com
(803)691-3421

Mr. Bryan Crist
El Dorado Engineering, Inc.
2964 West 4700 South
Salt Lake City UT 84118
bcrist@eldoradoengineering.com
(801)966-8288

Ms. Lou Crosby
Anniston Defense Munitions Center
7 Frankford Ave
Anniston AL 36201-4199
mary.s.crosby@us.army.mil
(256)240-3500

Ms. Donna Crow
Anniston Army Depot
7 Frankford Ave
Bldg 16
Anniston AL 36201
donna.crow@us.army.mil
(256)741-5123

Mr. Everette Crumpler III
Franklin Engineering
8005 East Van Hook
Milan TN 38358
ecrumpler3@bellsouth.net
(731)686-1776

Ms. Shannon Cunniff
Office of the Secretary of Defense
1225 South Clark Street
Arlington VA 22202
shannon.cunniff@osd.mil
(703)604-1529

Mrs. Monika Curcione
General Dynamics-OTS
11399 16th Court North, Suite 200
St. Petersburg FL 33716
(727)578-8196

Mr. Samuel Dallstream
Munitions Division, Army DCS G-4
ATTN: DALO-SMA, Room 1D343
500 Army Pentagon
Washington DC 20310-0500
samuel.dallstream@hqda.army.mil
(703)614-4058

Mr. Richard Davis
ECC
1240 Bayshore Hwy
Burlingame CA 94010
rdavis@ecc.net
(650)347-1555

Dr. Thomas DeAngelis
Science Applications International Corporation
Building 3028
Picatinny NJ 07806
thomas.p.deangelis@saic.com
(973)366-3200

Mr. Chris Deighton
PENTARCH P/L
Level 1, 99 Coventry Street
South Melbourne
Melbourne Victoria 3008
AUSTRALIA
c.deighton@pentarch.biz
61396828677

Mr. Christopher DiLorenzo
Defense Ammuniton Center
1 C Tree Road
Bldg. 35
McAlester OK 74501
christopher.dilorenzo@dac.army.mil
(918)420-8084

Ms. Cindy Diveley
Navy Operational Logistics Support Center
5450 Carisle Pike
P.o Box 2011
Mechanicsburg PA 17055
cindy.diveley@navy.mil
(717)605-2145

Mr. Paul Doherty
Camp Stanley Storage Activity
25800 Ralph Fair Road
Boerne TX 78015-4800
kenneth.lyons@us.army.mil
(210)295-7410

Ms. Kathy Donaldson
QuantiTech, Inc.
300 Voyager Way
Huntsville AL 35806
kathy.donaldson@us.army.mil
(256)650-6263 Ext. 206

Ms. Kyra Donnell
CH2M Hill
151 Lafayette Dr, Suite 110
Oak Ridge TN 37830
kdonnell@ch2m.com
(865)483-9032

Mr. Chris Dunn
2450 Crystal Dr
Ste 800
Arlington VA 22202-3895
chris_dunn@urscorp.com
(703)418-3070

Mr. Patrick Dupuis
Con Forces Ammuntion Depot
Dundurn
Littlecrow Avenue
Bldg 268
Dundurn SK S0K 1K0
CANADA
dupuis.pjc@forces.gc.ca
(306)492-2135

Mr. Glenn Earhart
ECC
1240 Bayshore Hwy
Burlingame CA 94010
gearhart@ecc.net
(650)347-1555

Mr. Neal Egan
MSE Technology Applications, Inc.
200 Technology Way
Butte MT 59701
neal.egan@mse-ta.com
(406)494-7367

Ms. Florence Elie-delacruz
U.S. ARMY RDECOM-ARDEC
AMSRD-AAR-AEE-P, Bldg 321
Picatinny Arsenal NJ 07806-5000
felie@pica.army.mil
(973)724-3859

Mr. James Elliott
General Atomics
3550 General Atomics
San Diego CA 92121
jim.elliott@ga.com
(858)455-3374

Ms. Tena Ellis
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
tena.ellis@us.army.mil
(918)420-8014

Mr. Stephen Emerson
QinetiQ
Bldg. 3
Environmental Test Center
Essex SS3 9XJ
UNITED KINGDOM
sjemerson@qinetiq.com
441702383035

Mr. David Emery
U.S. Army RDECOM-ARDEC
Bldg 321/ AMSRD-AAR-AEE-P
Picatinny Arsenal NJ 07806-5000
demery@pica.army.mil
(973)724-3332

COL(R) David Emling
Nammo Demil Division
Vingåkersverken
Vingåker 64392
SWEEDEN
ola.pikner@nammo.com
+46 151 19562

Mr. Bert Erickson
DDA Stragic Missiles
6011 Gum Lane
Hill Afb UT 84056-5826
bert.erickson@hill.af.mil
(801)775-3141

Dr. Eric Erickson
Naval Air Warfare Center Weapons Division
1900 N Knox Rd
Stop 6303, Code 498230D
China Lake CA 93555-6106
eric.d.erickson@navy.mil
(760)939-1638

Mr. Thomas Erickson
Day & Zimmermann, Inc.
2 S Maine Ave
Hawthorne NV 89415-9404
thomas.erickson3@us.army.mil
(775)945-7587

Mr. Donald Fanning
Tooele Army Depot
1 Tooele Army Depot
Bldg 1
Tooele UT 84074-5003
ronald.snyder@us.army.mil
(435)833-2694

Dr. David Fergensen
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore CA 94550
fergenson1@llnl.gov
(925)422-5530

Mr. Krag Filius
MSE Technology Applications, Inc.
200 Technology Way
Butte MT 59701
krag.filius@mse-ta.com
(406)494-7277

Mr. David Fincher
Explo Systems Inc.
1702 Fourth St
Louisiana Army Ammunition Plant
Minden LA 71055
explosystems@bellsouth.net
(318)382-8700

Mr. Earl Finley
QuantiTech, Inc.
300 Voyager Way
Suite 300
Huntsville AL 35806
earl.finley@quantitech.com
(256)650-6263

Mr. Tom Fitzgerald
Day & Zimmermann, Inc.
2 S Maine Ave
Hawthorne NV 89415-9404
thomas.fitzgerald2@us.army.mil
(775)945-7436

Mr. Daniel Flynn
U.S. Army RDECOM-ARDEC
Bldg 321
AMSRD-AAR-AEE-P
Picatinny Arsenal NJ 07806-5000
dflynn@pica.army.mil
(973)724-8036

Mr. John Follin
General Atomics
3550 General Atomics
San Diego CA 92121
john.follin@ga.com
(858)455-4405

Mr. Robert Ford
Safety Management Services
1847 W. 9000 S
West Jordan UT 84088
rford@sms-ink.com
(801)567-0456

Mr. Nicolas Forget
Defence Construction Canada
350 Albert Street
Constitution Square, 19th Floor
Ottawa ON K1A 0K3
CANADA
nicolas.forget@dcc-cdc-gc.ca
(613)998-4529

Mr. William Fortner
19th SC (E) Support Operations
Unit 5015
Box 931
APO AP 96218-5015
william.j.fortner@korea.army.mil
82534708903

Mr. Robert Fossey
University of Missouri-Rolla
1006 Kings Highway
Rolla MO 65409-0660
bubba@umr.edu
(573)341-4319

Mr. James Frankovic
Environmental Technology Division
US Army RDECOM-ARDEC
Picatinny Arsenal NJ 07806-5000
jfrank@pica.army.mil
(973)724-6239

Mr. Lyle Freeman
Premier Technology, Inc.
170 E. Siphon Rd.
Pocatello ID 83202
lfreeman@premiertechnology.cc
(208)760-0805

Mr. Brooks Fry
BAE Systems Ordnance Systems
4509 W. Stone Dr
Kingsport TN 37660
brooks.fry@baesystems.com
(423)578-6000

Mr. Richard Fuller
Joint Munitions Command
1 Rock Island Arsenal
SFSJM-LID
Rock Island IL 61299
richard.fullerjr@us.army.mil
(309)782-6306

Mr. Michael Gainer
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
michael.h.gainer@us.army.mil
(918)420-8904

Dr. Grzegorz Galecki
University of Missouri-Rolla
1006 Kingshighway St
Rolla MO 65401-2921
ggalecki@umr.edu
(573)341-4938

Mr. Michael Garner
Spreewerk Luebben
Börnichen 99
Lübben D-15907
GERMANY
tritsch@spreewerk.com
011-49- 3546 28 200

Mr. Josh Geary
NSWC, Crane Division
300 Highway 361
Code 4073, Bldg 2540
Crane IN 47501
joshua.geary@navy.mil
(812)854-6004

Mr. Steve Glaittli
ATK Thiokol
P.O. Box 707
Brigham City UT 84302
steve.glaittli@atk.com
(435)863-5890

Mr. Duane Goetsch
Gradient Technology
11080 Industrial Circle NW
Elk River MN 55330
goetsch@gradtech.com
(763)792-9990

Mr. Ronald Going
Day & Zimmermann, Inc.
9 South Main
Hawthorne NV 89415
ronald.going@us.army.mil
(775)945-7244

Mr. Robert Golden
McAlester Army Ammo Plant
1 C Tree Rd.
McAlester OK 74501-9002
robert.golden@us.army.mil
(918)420-6366

Mr. Ray Goldstein
U.S. Army ARDEC
Building 321
Picatinny NJ 07806-5000
rgold@pica.army.mil
(973)724-4122

Ms. Elena Graves
Defense Ammunition Center
1 C Tree Rd
Bldg. 35
McAlester OK 74501
elena.graves@us.army.mil
(918)420-8052

Ms. Kathy Grimes
Crane Army Ammunition Activity
300 Crane Hwy 361
Crane IN 45722
kathy.grimes1@us.army.mil
(812)854-5063

Mr. Ed Groth
Battelle Memorial Institute
1204 Technology Dr
Aberdeen MD 21001-1228
grothe@battelle.org
(410)306-8647

Dr. David Grymonpre
General Dynamics-OTS
10101 Dr Martin Luther King Jr St N
Saint Petersburg FL 33716-3807
dgrymonpre@stp.gd-ots.com
(727)578-8363

Mr. Larry Gulledge
159 Bason St
Oakman AL 35579-3226
gulledgebiz@tds.net
(205)622-2327

Mr. George Gunderman
Tennessee Valley Authority
PO Box 1010 CTR 2U
Muscle Shoals AL 35662-1010
glgunderman@tva.gov
(256)386-2770

Mr. Larry Gunter
U.S. Army Aviation and Missile Command
AMSAM-OPS-O
Bldg 5308
Redstone Arsenal AL 35898
larry.gunter@us.army.mil
(256)313-1645

Mr. Terry Hachett
Joint Munitions Command
1 Rock Island Arsenal
SFSJM-LID
Rock Island IL 61299
terry.hackett@us.army.mil
(304)782-6881

Mr. Ronald Hackler
Valentec Systems Inc.
2629 York Avenue
Minden LA 71055
rhackler@valentec.net
(318)382-0933

Mr. Joakim Hagvall
FOI-Swedish Defence Research Agency
Grindsjon Research Centre
Tumba SE-14725
SWEEDEN
joakim.hagvall@foi.se
468555039

Mr. James Hale
USARPAC DDCS G-4
USARPAC
APLG-MUM Bldg T-122
Fort Shafter HI 96858-5100
halej@shafter.army.mil
(808)438-8103

Mr. Mark Hancock
NSWC, Indian Head Division
101 Strauss Ave.
Indian Head MD 20640
mark.hancock@navy.mil
(301)744-4279

Mr. Kevin Hansen
TPL, Inc.
3921 Academy Parkway North, NE
Albuquerque NM 87109-4416
khansen@tplinc.com
(505)344-6744

Dr. Marcel Hanus
OZM Research
Nadrazni 266
Hrochuv Tynec 53862
CZECH REPUBLIC
hanus@ozm.cz
00420608746932

Dr. James Harmon
Oklahoma State University
Dept. of Physics
Stillwater OK 74078
james.harmon@osu.edu
(405)744-9692

Mr. Darwin Harting
Indiana Ordnance Works Inc.
11452 Hwy 62
Ste 124
Charlestown IN 47111-1240
dharting@iowinc.com
(812)256-4478

Ms. Terri Haskins
Science Applications International Corporation
Building 3028
Picatinny Arsenal NJ 07806
terri.haskins@pica.army.mil
(973)366-7842

Mr. Donald Hastings
AMTEC Corporation
500 Wynn Dr
Ste. 314
Huntsville AL 35816-3429
lhastings@amtec-corp.com
(256)313-8095

Mr. Ralph Hayes
El Dorado Engineering, Inc.
2964 West 4700 South
Salt Lake City UT 84118
eldorado50@aol.com
(801)966-8288

Mr. Harley Heaton
UXB International, Inc.
1715 Pratt Dr
Blacksburg VA 24060
harley.heaton@uxb.com
(540)443-3700

Ms. Diana-Lynn Herbst
U.S. Army RDECOM-ARDEC
Bldg.355
Picatinny Arsenal NJ 07806-5000
dianalynn.herbst@us.army.mil
(973)724-4914

Dr. Dov Herskowits
Exploxive Manufacturing Industries
P.O. Box 17
Zichron-Jacob 30900
ISRAEL
dovh@explosives.co.il
97246299002

Mr. Harrell Hignight
Red River Munitions Center
100 Main
Texarkana TX 75507-5000
hhignight@redriver-ex.army.mil
(903)334-2437

Mr. Ivan Chin Kian Ho
Defence Science & Technology Agency
1 Depot Rd
#03-01j
Singapore 109679
SINGAPORE
hliamchi@dsta.gov.sg
(656)373-2103

Mr. Gary Holbrook
Tooele Army Depot
1 Tooele Army Depot
Bldg. 1005
Tooele UT 84074
holbroog@emh2.toole.army.mil
(435)833-5014

Mr. Malcolm Holden
QinetiQ Inc
ETC Foulness Island
Shoeburyness Essex SS3 9XJ
UNITED KINGDOM
mjholden@qinetiq.com
441702383045

Mr. Richard Holthouser
Pika International Inc.
12919 Southwest Freeway
Suite 190
Stafford TX 77477
rholthouser@pikainc.com
(281)340-5525

Ms. Susan Honaker
ECC
1240 Bayshore Hwy
Burlingame CA 94010
shonaker@ecc.net
(650)347-1555

Mr. Peter Honey
QinetiQ
MoD Shoeburyness
Southend-on-Sea SS3 9SR
UNITED KINGDOM
pjhoney@tiscali.co.uk
1702383316

Ms. Deborah Hookway
Camber Corporation
9 Grove Terrace
Sparta NJ 07871-1313
dhookway@pica.army.mil
(973)724-2450

Ms. Sheri Hopewell
U.S. Army ARDEC
Building 321
Picatinny NJ 07806-5000
hopewell@pica.army.mil
(973)724-5690

Mr. Orest Hrycak
PEO Ammo, OPM Demil
Attn: SFAE-AMO-JS-D
Bldg. 171 Annex
Picatinny Arsenal NJ 07806-5000
ohrycak@pica.army.mil
(973)724-6937

Dr. Peter Hsu
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore CA 94550
hsu7@llnl.gov
(925)422-0317

Mr. Craig Huber
Building 900
9700 S. Cass Ave
Argonne IL 60439
huber@anl.gov
(630)252-3276

Mr. Jim Humphrey
QuantiTech, Inc.
300 Voyager Way
Huntsville AL 35806
james.humphrey5@us.army.mil
(256)650-6263 Ext. 206

Mr. Brent Hunt
Ammunition Equipment Directorate
1 Tooele Army Depot
Bldg. 9
Tooele UT 84074
brent.hunt@us.army.mil
(435)833-5045

Mr. Paul Ihrke
PIKA International, inc.
12919 Southwest Freeway
STAFFORD TX 77477
pihrke@pikainc.com
(281)340-5525

Dr. Tsuyoshi Imakita
Kobelco Research Institute, Inc.
1-5-5
Takatsuksdai
Nishi-ku
Kobe 651-2271
JAPAN
imakita@kobelcokoken.co.jp
011810789925193

Ms. Heidi Jacobus
Cybernet Systems Corporation
727 Airport Blvd.
Ann Arbor MI 48108
heidi@cybernet.com
(734)668-2567

Mr. James Jensen
Bowen, Collins & Associates
756 East 12200 South
Draper UT 84020
jjensen@bowencollins.com
(801)495-2224

Mr. Gyu Bong Jeong
HQ Army of ROK
PO box #501-7, Boonam-ri, namseon-myeon, Gyeryong-si, Chungnam, South Korea
Gyeryong
SOUTH KOREA
saclos2000@yahoo.co.kr
0425504240

Mr. Michael Johnson
NSWC, Crane Division
300 Highway 361
Bldg 2540
Crane IN 47522-5001
michael.e.johnson1@navy.mil
(812)854-5665

Mr. Randy Johnson
TPL, Inc.
3921 Academy Parkway North Ne
Albuquerque NM 87109
rajohnson@tplinc.com
(505)344-6744

Mr. Darwin Jones
Tooele Army Depot
1 Tooele Army Depot
Bldg 1
Tooele UT 84074-5003
darwin.jones@us.army.mil
(435)833-2694

Mr. Gene Jordan
Anniston Defense Munitions Center
7 Frankford Ave
Anniston AL 36201-4199
gene.l.jordan@us.army.mil
(256)235-4155

Ms. Monique Juegler
EBV Explosives Environmental Company
P.O. Box 1386
Joplin MO 64802
monique.juegler@ebveec.com
(417)624-0212

Mr. Stanley Kahn
U.S. Army ARDEC
Bldg 94
Picatinny NJ 07806
skahn@pica.army.mil
(973)724-5915

Mr. Joel Kallenberger
Blue Grass Army Depot
2091 Kingston Hwy
Richmond KY 40475-5105
joel.kallenberger@us.army.mil
(859)779-6605

Mr. Shahrukh Kanga
Pika International, Inc.
12919 Southwest Freeway
Suite 190
Stafford TX 77477
skanga@pikainc.com
(281)340-5525

Ms. Rose-Marie Karlsson
FOI Swedish Defence Research Agency
Grindsjon Research Centre
Tumba SE-14725
SWITZERLAND
rmkar@foi.se
468 5550 4040

Mr. Nand Kaushik
Arctech, Inc.
14100 Park Meadow Dr.
Chantilly VA 20151
nkaushik@archtech.com
(703)222-0280

Mr. Phillip Keith
NSWC, Crane Division
300 HWY 361
bldg. 361
Crane IN 47522
phillip.keith@navy.mil
(812)854-6157

Mr. William Kelso
Parsons
1700 BRdway Ste 900
Denver CO 80290-0901
william.kelso@parsons.com
(303)764-1932

Mr. Paul Kendall
GEOMET Technologies, LLC
20251 Century Boulevard
Germantown MD 20874-1192
pkendall@geomet.com
(301)428-9898

Mr. Kevin Kennedy
Chemical Compliance Systems, Inc.
706 State Route 15 S Ste 207
Lake Hopatcong NJ 07849-2250
kevinkennedy@chemply.com
(973)663-2148

Mr. Harvard Kim
95-102 Paikauhale Place
Mililani HI 96789
kimh054@hawaii.rr.com
(808)256-7355

Dr. Jae-Kyung Kim
Agency for Defense Development
Yuseung P.O.Box 35-5
Yuseung/Daejon 305-600
SOUTH KOREA
jaekkim@add.re.kr
82428214164

Dr. Sunhwan Kim
R & D Center HANWHA Co.
52-1 Wotsam-dong Yuseong-gu
Daejon 305-156
SOUTH KOREA
shkim@hanwha.co.kr
82427292430

Mr. Tony King
U.S. Army AMCOM G-3
AMCOM G-3
AMSAM-OPS-O
Redstone Arsenal AL 35898
Tony.King@redstone.army.mil
(256)842-0814

LTC Andre Kirnes
Department of the Army
SFAE-AMO-JS
Building 171
Picatinny Arsenal NJ 07806-5000
akirnes@pica.army.mil
(973)724-7073

Mr. Ryusuke Kitamura
Kobe Steel Ltd
2-7 4-chome IWAYANAKAMACHL
NADA-KU
Kobe 657-0845
JAPAN
r.kitamura@engnet.kobelco.co.jp
011810782617942

Mr. Paul Klara
U.S. Army Aberdeen Test Center
400 Colleran Rd
CSTE-DTC-AT-SL-ME
Aberdeen Proving Grd MD 21005-
5059
paul.klara@atc.army.mil
(410)278-4729

Mr. Young-Hoon Kong
HQ Army of ROK
PO box #501-7, Boonam-ri, namseon-
myeon, Gyeryong-si, Chungnam,
South Korea
Gyeryong
SOUTH KOREA
kammo48@empal.com
0425504245

Ms. Paula Kramer
Tooele Army Depot
1 Tooele Army Depot
Bldg 1
Tooele UT 84074-5003
paula.kramer@us.army.mil
(435)833-2694

Mr. Shinya Kuwahara
Kobe Steel Ltd.
Kitashinagawa 5 cyome 9-12
Shinagawa Tokyo 657-0845
JAPAN
s.kuwahara@engnet.kobelco.co.jp
81.78.261.7042

Dr. Solim Kwak
Defense Ammunition Center
1 C Tree Rd, Bldg 35
McAlester OK 74501
solim.kwak@dac.army.mil
(918)420-8084

Mr. Douglas Lamothe
ECC
1240 Bayshore Hwy
Burlingame CA 94010
dlamothe@ecc.net
(650)347-1555 ext 151

Mr. John Landgraf
Crane Army Ammunition Activity
300 Highway 361
Crane IN 47522
landgrafj@crane.army.mil
(812)854-5455

Ms. Lorraine Larsen-hallock
Cal-EPA
8800 Cal Center Dr
Sacramento CA 95826
llarsenh@dtsc.ca.gov
(916)255-3578

Mr. Mike Lasher
MSE Technology Applications, Inc.
200 Technology Way
P.O. Box 4078
Butte MT 59711
mike.lasher@mse-ta.com
(406)494-7252

Mr. Chad Lasson
El Dorado Engineering, Inc.
2964 West 4700 South
Salt Lake City UT 84118
chad@eldoradoengineering.com
(801)966-8288

Mr. Keith LaTorre
1093 Commerce Park Dr
Ste 100
Oak Ridge TN 37830-8029
keith_latorre@urscorp.com
(865)220-8113

Mr. David Lawson
Department of Environmental Quality
707 North Robinson
P.O. Box 1677
Oklahoma City OK 73101-1677
david.lawson@dea.gov
(405)702-1116

Miss Eumsoon Lee
Military of National Denfense
22 Etaewon-Ro
Yongsan-Gu
Seoul 140-701
SOUTH KOREA
ledoi012@hotmail.com
822748-5708

Mr. Jeff Lee
U.S. Army ARDEC
AMSRD-AMR-PS-S
Bldg 7120
Redstone Arsenal AL 35898
Jeffrey.L.Lee@us.army.mil
(256)842-6514

Mr. Jung Ho Lee
Hanwha Corporation
Hanwha Bldg 25th Floor #1
Changgyo-Dong
Seoul 100-797
SOUTH KOREA
furseal@hanwha.co.kr
82 2 729 1757

Mr. K.C. Lee
Explomd T.S. PTE LTD
80 Genting Lane
05-06
Genting Blk 34965
SINGAPORE
jameslee@explomo.com
(656)741-7855

Mr. Kisoo Lee
Ministry of National Defense
22 Itaewon-Ro
Yongsan-Gu
Seoul 140-701
SOUTH KOREA
lks22200@yahoo.co.kr
8227485740

Ms. Jennifer Lefeaux
Defense Group Inc.
Raleigh NC 27601
jlefeaux@earthlink.net

Mr. Louis Lemay
Defence Construction Canada
350 Albert Street
Constituiton Square, 19th Floor
Ottawa ON K1A 0K3
CANADA
louis.lemay@dcc-cdc.gc.ca
(613)998-7287

Mr. Noah Lieb
Hughes Associates, Inc.
3610 Commerce Dr
Ste 817
Baltimore MD 21227-1652
noahjbl@yahoo.com
(410)737-8677

Mr. Louis Ligeno
Joint Munitions Command
1 Rock Island Arsenal
SFSJM-CTD
Rock Island IL 61299-6500
LIGENOL@AFSC.ARMY.MIL
(309)782-8583

Mr. Mitch Lindsay
CH2M Hill
215 South State Street, Suite 1000
Salt Lake City UT 84111
mitch.lindsay@ch2m.com
(435)901-8709

Mr. Lyn Little
Defense Ammunition Center
1 C-Tree Rd
Bldg 35
McAlester OK 74501-9002
lyn.little@us.army.mil
(918)420-8808

Mr. Christopher Livingston
Battelle Memorial Institute
1204 Technology Dr
Aberdeen MD 21001-1228
livingstonc@battelle.org
(410)306-8677

Mr. Tony Livingston
Joint Munitions Command
1 Rock Island Arseal
SFSJM-LID
Rock Island IL 61299-6500
LIVINGSTONT@AFSC.ARMY.MIL
(309)782-0082

Mr. Jim Lohr
PIKA International, inc.
12919 Southwest Freeway
Stafford TX 77477
jlohr@pikainc.com
(281)340-5525

Mr. Kevin Lombardo
CH2M Hill
13921 Park Center Road
Herndon VA 20171
kevin.lombardo@ch2m.com
(703)471-6405

Mr. Jerry Lusk
Navy Operational Logistics Support Center
5450 Carisle Pike
P.o Box 2011
Mechanicsburg PA 17055
jerry.lusk@navy.mil
(717)605-3801

Ms. Catherine Malins
TPL, Inc.
3921 Academy Parkway North Ne
Albuquerque NM 87109
cmalins@tplinc.com
(505)344-6744

Mr. William Manion
Energetic Systems, Inc. LLC
56 Bello Point Dr
Sunrise Beach MO 65079
Wmanion@sbcglobal.net
(573)286-1507

Mr. James Marsh
e-PEAK Inc. SDVOSB
311 Diamond Oaks Dr
Weatherford TX 76087
jmarsh@epeak.biz
(817)596-8656

Ms. Janet Martin
Defense Ammunition Center
1579 Hoadley Road
Bldg 4430
Aberdeen Proving Grd MD 21010
janet.martin@aec.apgea.army.mil
(410)436-6839

Mr. Keith Martin
American Ordnance LLC
2280 Hwy 104 West
Suite 2
Milan TN 38358
(731)686-6957

Mr. John Masengarb
QuantiTech, Inc.
300 Voyager Way
Huntsville AL 35806
john.masengarb1@us.army.mil
(256)650-6263 Ext. 206

Mr. Shin Masuda
NOF Corporation
9434 Dwyer Ct
Durham CA 95938-9402
shinmasuda@earthlink.net
(530)892-1355

Mr. Scott Matthews
Science Applications International Corporation
RR 6 Box 28
Bloomfield IN 47424
scott.a.matthews@saic.com
(812)384-3587 ext 207

Mr. Barry McCall
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
barry.mccall@dac.army.mil
(918)420-8198

Mr. Paul McDaniel
McAlester Army Ammunition Plant
SJMMC-MO
1 C Tree Rd.
McAlester OK 74501
paul.mcdaniel@mcaap.army.mil
(918)420-6452

Dr. Michael Mcfarland
Utah State University
1405 Mount Logan Dr
Logan UT 84321
farlandm@msn.com
(435)753-3608

Mrs. Tiffany McGregor
NSWC, Indian Head Division
101 Strauss Ave
Bldg. 302
Indian Head MD 20640-1542
tiffany.mcgregor@navy.mil
(301)744-1471

Mr. John McIlrath
Tetra Tech, Inc.
4960 Corporate Dr NW
Ste 140
Huntsville AL 35805-6209
jmcilrath@tteci.com
(256)430-3621

Mr. Chris McLean
U.S. Army Developmental Test Command
314 Longs Corner Rd
Aberdeen Proving Grd MD 21005-5057
canadianflo@dtc.army.mil
(410)278-1072

Ms. Holly Mendonca
Sandia National Laboratories
P.O. Box 969
Livermore CA 94550-0969
hlmendo@sandia.gov
(925)294-2199

Mr. Gary Mescavage
U.S. Army ARDEC
Building 321
Picatinny NJ 07806-5000
gmescava@pica.army.mil
(973)724-4122

Mr. Cliff Metcalf
TRI-Rinse, Inc.
5200 Manchester
St. Louis MO 63110
cliff@tririnse.com
(314)647-8338

Mr. Wilfried Meyer
General Dynamics-OTS
11399 16th Ct. North, Suite 200
St. Petersburg FL 33716
wmeyer@gd-ots.com
(727)578-8274

Mr. Jerry Miller
Tooele Army Depot
Bldg. 1005
Tooele UT 84074
millerj@emh2.tooele.army.mil
(435)833-5048

Mr. Paul Miller
Gradient Technology
11080 Industrial Circle NW
Elk River MN 55330
miller@gradtech.com
(763)792-9990

Mr. Robert Miller
Defense Ammunition Center
1 C Tree Road
Building 35
McAllester OK 74501
robert.w.miller2@us.army.mil
(918)420-8399

Mr. Alfred Mitchell III
P.O. Box 348
Columbus KS 66725
jmitchell@energetic-sys.com
(620)597-2552

Ms. Linda Mitrik
General Dynamics-OTS
11399 16th Court N.
Suite 200
St. Petersburg FL 33714
(727)578-8100

Mr. Roger Montoya
USAF Hill Air Force Base
7302 Wardleigh Road
Bldg. 15
Hill AFB UT 84056-5008
roger.montoya@hill.af.mil
(801)777-1546

Mr. Majid Moosavi
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
majid.moosavi@dac.army.mil
(918)420-8474

Mr. Thane Morgan
TPL, Inc.
3921 Academy Parkway North NE
Albuquerque NM 87109
tmorgan@tplinc.com
(505)344-6744

Mr. Yasuhiro Morimoto
Kobe Steel Ltd.
Kitashinagawa 5 cyome9-12
Shinagawa Tokyo 657-0845
JAPAN
yasu.morimoto@engnet.kobelco.co.jp
81.78.261.7042

Mr. Amnon Mozes
Red Wings Ltd.
10,Plaut Str.
P.O.Box 2062
Rehovot 76120
ISRAEL
amnon@redwings.co.il
97289473993

Dr. Gert Mueller
BAE Systems Ordnance Systems
4509 W Stone Dr
Kingsport TN 37660-9009
gert.mueller@baessytems.com
(423)578-6000

Mr. Arthur Mulack
350 Albert Sreet
Constitution Square 19th Floor
Ottawa ON K1A0K3
CANADA
Arthur.Mulack@dcc-cdc.gc.ca
(613)991-9975

Mr. Stephen Mullins
NDCEE
100 CTC Dr
Johnstown PA 15904
mullins_stephen@bah.com
(814)269-2870

Mr. Paul Myrick
Lockheed Martin Corporation
1550 Crystal Dr
Suite 404
Arlington VA 22202
paul.myrick@lmco.com
(703)413-5240

Mr. Kenneth Napier
Cybernet Systems Corporation
727 Airport Blvd.
Ann Arbor MI 48108
knapier@cybernet.com
(734)668-2567

Mr. Stuart Nemiroff
WECAC, ARDEC
Attn: AMSTA-AR-WES
Bldg. 321
Picatinny Arsenal NJ 07806-5000
stunmn@verizon.net
(973)724-4087

Mr. Max Newman
UXB International, Inc.
15725 W Huntley Ct
Surprise AZ 85374-5647
colonelbluemax@aol.com
(623)546-3905

Dr. Karl Nieman
Select Engineering Services
75th CEG/CEV 7274 Wardleigh Road
Hill Air Force Base UT 84056-5137
karl.nieman@hill.af.mil
(801)777-5788

Mr. Tyrone Nordquist
Defense Ammunition Center
1 C-Tree Rd
Bldg 35
McAlester OK 74501-9002
tyrone.nordquist@dac.army.mil
(918)420-8044

Mr. Larry Nortunen
Defense Ammunition Center
1 C-Tree Rd
Bldg. 35
McAlester OK 74501-9053
larry.nortunen@us.army.mil
(918)420-8093

Mr. David Nydam
Dynasty Enterprises
11741 Briarglen Lane
Sandy UT 84092-5454
twonydams@aol.com
(801)523-6074

Ms. Dorothy Olson
Defense Ammunition Center
1 C-Tree Rd
Bldg. 35
McAlester OK 74501-9002
dorothy.olson@dac.army.mil
(918)420-8271

Mr. Gregory Olson
Defense Ammunition Center
1 C-Tree Rd
Bldg. 35
McAlester OK 74501-9053
greg.olson@dac.army.mil
(918)420-8084

Mr. Harry Olson
Tooele Army Depot
1 Tooele Army Depot
Bldg. 1250
Toole UT 84074
harry.olson@us.army.mil
(435)833-2512

Mr. Charles Overton
Science Applications International Corporation
RR 6 Bpx28, Hwy 231 South
Bloomfield IN 47424
overtonch@saic.com
(812)384-3587

Mr. Charles Painter
NSWC, Indian Head Division
101 Strauss Ave.
Indian Head MD 20640
charles.r.painter@navy.mil
(301)744-6772

Mr. Donald Parker
University of Missouri-Rolla
1006 Kings Highway
Rolla MO 65409-0660
parkerds@umr.edu
(573)341-4750

Mr. Russell Patterson
General Dynamics-OTS
11399 16th Ct. North, Suite 200
St. Petersburg FL 33716
rpatterson@gd-ots.com
(727)578-8274

Mr. Raymond Pawlicki
U.S. Army ARDEC
Bldg. 3022, Room 222
Rt 15 South
Picatinny Arsenal NJ 07806-5000
raymond.pawlick@us.army.mil
(973)724-3386

Mr. Steven Penrod
Defense Ammunition Center
1 C-Tree Road Bldg 35
McAlester OK 74501-9002
steven.penrod@us.army.mil
(918)420-8925

Mr. Woody Pike
Letterkenny Munitions Center
1 Overcash Ave
Chambersburg PA 17201-4150
elwood.pike@us.army.mil
(717)267-8302

Mr. Ola Pikner
Nammo Demil Division
P.O. Box 426
Moline IL 61266-0426
emling@pbnammo.com
(309)732-1758

Mr. Randy Pipes
McAlester Army Ammunition Plant
SJMMC-MO
1 C Tree Rd.
McAlester OK 74501
randy.pipes@mcaap.army.mil
(918)420-6452

Mr. Craig Powers
Defense Ammunition Center
1 C Tree Rd
Bldg. 35
McAlester OK 74501
craig.a.powers@us.army.mil
(435)833-2679

Mr. William Priester
U.S. ARMY TACOM ARDEC
Armament Tech Fac, Bldg. 355
Picatinny Arsenal NJ 07806-5000
priester@pica.army.mil
(973)724-7316

Mr. Cesar Pruneda
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore CA 94550
pruneda1@llnl.gov
(925)422-0460

LTC Brian Raftery
PEO Ammo, PM Joint Services
Buffington Road
Bldg. 171A
Picatinny Arsenal NJ 07806
brian.raftery@us.army.mil
(973)724-5276

Mr. Bruce Ramm
Defense Ammunition Center
1 C Tree Road
Bldg. 35
McAlester OK 74501-9053
bruce.ramm@DAC.army.mil
(918)420-8978

Mr. G. M. Rana
PIKA International, inc.
12919 Southwest Freeway
Stafford TX 77477
grana@pikainc.com
(281)340-5525

Mr. Chris Reams
IHDIVNSWC Yorktown Detachment
P.O. Drawer 160
Yorktown VA 23691-0160
reamscs@nswc.nwsy.navy.mil
(757)887-4762

Mr. Merle Reynolds
Tooele Army Depot
1 Toole Army Depot Bldg. 8
SJMTE-CS-EO
Toole UT 89074
merle.reynolds@us.army.mil
(435)833-3248

Dr. Jeffrey Riggs
Defense Group Inc.
2034 Eisenhower Avenue
Suite 115
Alexandria VA 22314
jeffrey.riggs@biowarnllc.com
(301)926-9050

Ms. Beverly Rikala
8800 Cal Center Dr
Sacramento CA 95826
brikala@dtsc.ca.gov
(916)255-3746

Ms. Rosalie Riker
Defense Ammunition Center
9301 Chapek Rd
Bldg 1
Fort Belvoir VA 22060-5605
rikerr@hqamc.army.mil
(703)806-9026

Mr. Rob Rising
General Atomics
3550 General Atomics
San Diego CA 92121
robert.rising@ga.com
(858)455-3915

Mr. Stanley Rising
AFRL/MLQL
139 Barnes Dr
Ste 2
Tyndall AFB FL 32403-5323
stan.rising@tyndall.af.mil
(850)283-6290

Mr. Tim Rivers
MSE Technology Applications, Inc.
200 Technology Way
Butte MT 59701
tim.rivers@mse-ta.com
(406)494-7406

Mr. Jason Robinson
Oklahoma State University
145 Physical Science
Stillwater OK 74078
jason.robinson@okstate.edu
(405)794-7982

Dr. William Rogers
PO Box 1010
Muscle Shoals AL 35661
wjrogers@tva.gov
(256)386-3774

Mr. Bill Roman
Nammo Demil Division
One Penn Plaza
New York NY 10119
roman@pbworld.com
(212)465-5023

Mr. Seb Romano
CH2M Hill
133921 Park Center Road
Suite 600
Herndon VA 20171
seb.romano@ch2m.com
(703)471-6405

Mr. Jean-Luc Rosso
CDN Forces Ammuntion Depot
Dundurn
Little Crow Avenue
Bldg 268
Dundurn SK S0K 1K0
CANADA
rosso.jj@forces.gc.ca
(306)492-2135

Mr. William Roy
EBV Explosives Environmental
Company
PO Box 1386
Joplin MO 64802-1386
wil.roy@ebveec.com
(417)624-0212

Mr. William Rueb
Washington Group Intl. Inc.
1500 W 3rd St
MK-Ferguson Plaza
Cleveland OH 44113-1406
bill.rueb@wgint.com
(216)523-5911

Mr. Jeff Ruffner
MSE Technology Applications, Inc.
200 Technology Way
Butte MT 59701
jeff.ruffner@mse-ta.com
(406)494-7450

Mr. Lee Rulis
ATK Thiokol
P.O. Box 707
Brigham City UT 84301-0707
lee.rulis@atk.com
(435)863-3020

Mr. Leland Russell
Tooele Army Depot
Attn: SJMTE-RSM
Building 1001
Tooele UT 84074-5003
leland.russell@us.army.mil
(435)833-2679

Mr. Barry Schaffer
Gradient Technology
11080 Industrial Circle NW
Elk River MN 55330
BRS261@aol.com
(763)792-9990

Mr. Steve Schmit
Gradient Technology
11080 Industrial Circle NW
Elk River MN 55330
schmit@gradtech.com
(763)792-9990

Mr. Joe Schuppel
NSWC, Indian Head Division
101 Strauss Ave
Indian Head MD 20640
joseph.schuppel@navy.mil
(301)744-2207

Mr. Brian Schweitzer
NDCEE
100 CTC Dr
Johnstown PA 15904
schweitz@ctc.com
(814)269-2772

Mr. John Sedlak
VSE Corporation
2550 Huntington Avenue
Alexandria VA 22303
jsedlak@vsecorp.com
(301)743-9120

Ms. Karen Shaw
Science Applications International
Corporation
Building 3028
Picatinny Arsenal NJ 07806-5000
kshaw@pica.army.mil
(973)366-0712

Ms. Pamela Sheehan
Contractor
AETC-EWETD-ETD
Building 355
Picatinny NJ 07806-5000
pamela.sheehan@us.army.mil
(973)724-2989

Ms. Ann Sherrard
Los Alamos National Laboratory
MS C924
Los Alamos NM 87545
sherrard@lanl.gov
(505)665-7226

Mr. John Shocklee
TRI-Rinse, Inc.
5200 Manchester
St. Louis MO 63110
jshocklee@tririnse.com
(314)647-8338

Ms. Debbie Sitton
Day & Zimmermann, Inc.
9 S. Main
Hawthorne NV 89415-9404
debbie.sitton@us.army.mil
(775)945-7275

Mr. Mike Skillicorn
General Atomics
3550 General Atomics
San Diego CA 92121
mike.skillicorn@ga.com
(858)455-2855

Ms. April Smith
Science Applications International Corporation
RR 6 Box 28
Bloomfield IN 47424
april.m.smith@saic.com
(812)384-3587 ext 289

Ms. Carolyn Smith
Defense Group Inc.
2034 Eisenhower Avenue
Suite 115
Alexandria VA 22314
carolyn.smith@defensegp.com
(703)706-4157

Mr. David Smith
Explo Systems, Inc.
1702 Fourth St
Louisiana Army Ammunition Plant
Minden LA 71055
explosystems@bellsouth.net
(318)382-8700

Ms. Doni Smith
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
adonica.smith@us.army.mil
(918)420-8084

Mr. Nick Smith
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
robert.n.smith@us.army.mil
(918)420-8139

COL Todd Smith
Crane Army Ammunition Activity
300 Highway 361
Crane IN 47522
(812)854-1484

Mr. Rick Snow
TPL, Inc
3921 Acedemy Parkway North, NE
Albuquerque NM 87109
rsnow@tplinc.com
(505)344-6744

Mr. John Sonday
Accurate Energetic Systems, LLC
5891 Hwy. 230 West
McEwen TN 37101
pittman@aesys.biz
(931)729-6601

Mr. Robert Sontheimer
General Dynamics Corporation
11399 16th Ct. North
Suite #200
Saint Petersburg FL 33716-2328
rrsontheimer@gd-ots.com
(727)578-8318

MAJ Prevost Sophie
CANOSCOM
555 dc la Cacciece
LSTL 3rd Floor
Gatineau QC K1A 0K2
CANADA
prevost.mms@forces.gc.ca
(819)994-4758

Mr. Larry Sparks
Washington Group International
2345 Crystal Dr
Suite 708
Arlington VA 22202
Larry.Sparks@wgint.com
(703)236-2724

Mr. Michael Spritzer
General Atomics
PO Box 85608
San Diego CA 92186-5608
michael.spritzer@gat.com
(858)455-2185

Mr. Jerry Spurlock
Equalizer Company
315 B Gadsden Hwy
Birmingham AL 35235
jerry@spurlockscrap.com
(334)268-0677

Ms. Karen Stasell
General Dynamics-OTS
11399 16th Ct. North, Suite 200
St. Petersburg FL 33716
kstasell@gd-ots.com
(727)578-8274

Mr. John Stine
UXB International, Inc.
190 Lime Quarry Road
Madison AL 35758
john.stine@uxb.com
(540)443-3700

Mr. Harold Stoller
TPL, Inc.
3921 Academy Parkway North Ne
Albuquerque NM 87109
hstoller@tplinc.com
(505)344-6744

Mr. John Strange Jr.
QuantiTech, Inc.
300 Voyager Way
Suite 300
Huntsville AL 35806
john.strangejr@restone.army.mil
(256)650-6263

Mr. Charles Streck Jr.
U.S. Army Corps of Engineers,
Honolulu District
CEPOH-PP-E
Bldg. 230
Fort Shafter HI 96858-5440
chuck.f.streck@poh01.usace.army.mil
(808)438-6934

Mr. Francis Sullivan
U.S. ARMY RDECOM-ARDEC
AMSRD-AAR-AEE-P
Bldg 321
Picatinny NJ 07806-5000
fsulliv@pica.army.mil
(973)724-3538

Dr. David Summers
University of Missouri-Rolla
1006 Kingshighway St
Rolla MO 65401-2921
dsummers@umr.edu
(573)341-4314

LTC John Summers
Hawthorne Army Depot
1 S. Maine Avenue
Hawthorne NV 89415-9404
johnny.summersj@us.army.mil
(775)945-7001

Mr. Ralph Swanson
Equalizer Company
315 B Gadsden Hwy
Birmingham AL 35235
legendcockers@earthlink.net
(205)862-0722

Mr. Kevin Tang
Cybernet Systems Corporation
727 Airport Blvd.
Ann Arbor MI 48108
ktang@cybernet.com
(734)668-2567

Dr. George Thompson
Chemical Compliance Systems, Inc.
706 State Route 15 South
Suite 207
Lake Hopatcong NJ 07849-2250
georgethompson@chemply.com
(973)663-2148

Mr. Gerald Thompson
Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
gerald.thompson1@us.army.mil
(918)420-8924

Ms. Janessa Tollett
Anniston Defense Munitions Center
7 Frankford Ave
Anniston AL 36201-4199
janessa.tollett@us.army.mil
(256)235-4310

2006 Global Demil Symposium and Exhibition
Attendees List

Mr. Lyle Torongeau Jr.
Perkins Technical Program Anayslt
6767 Old Madison Pike
Suite 275
Huntsville AL 35806
ltorongeau@pts-inc.com
(256)539-6787

Mr. David Towndrow
Defence General Munitions Integrated Project Team
DGM IPT
Spur 9, Crescent Block
Ensleigh Site
Bath BA1 5AB
UNITED KINGDOM
sean.hockram342@mod.uk
441225467919

Mr. Hermann Tritsch
Spreewerk Luebben
Börnichen 99
Lübben D-15907
GERMANY
gwickede@spreewerk.com
011-49 3546 28 200

Mr. Massaya Ueda
Kobe Steel Ltd.
2-7-4 chome Iwayanakamachi Nada-ku, Kobe, 657-0845
Kobe 657-0845
JAPAN
m.ueda@engnet.kobelco.co.jp

Mr. Bobby Van Rensburg
Accurate Energetic Systems, LLC
5891 Highway 230 W
Mc Ewen TN 37101-3971
vanrensburg@aesys.biz
(931)729-6608

Mr. Isar Veksler
IMI Service USA, Inc.
7910 Woodmont Ave
Suite 1410
Bethesda MD 20814
isarv@imi-israel.com
(301)215-4821

Mr. Petr Vicenik
Dlouha 300
Slaviein 76321
CZECH REPUBLIC
pvicenik@vtuvm.cz
420 603 786 97

Dr. Gert von Wickede
Spreewerk Luebben
Börnichen 99
Lübben D-15907
GERMANY
azachow@spreewerk.de
011-49 3546 28 200

Mr. Terrell Wafford
McAlester Army Ammunition Plant
1 C-Tree Road
SJMMC-DE/Building 6
McAlester OK 74501-9002
terrell.wafford@us.army.mil
(918)420-6688

Mr. Daman Walia
Arctech, Inc.
14100 Park Meadow Dr
Chantilly VA 20151
dwalia@arctech.com
(703)222-0280

Mr. Lewis Walker
Oklahoma State University
1223 Falster Road
Alexandria VA 22308-1811
dwalker-trc@verizon.net
(703)239-1028

Mr. Karl Wally
Sandia National Laboratories
P.O. Box 969, MS9291
Livermore CA 94551-0969
kwally@sandia.gov
(925)294-2597

Mr. Scott Walton
Argonne National Laboratory
9700 S. Cass Ave
Bldg. 900 MS-10
Argonne IL 60439
swalton@anl.gov
(630)252-1863

Mr. Dennis Wanlass
Dyno Nobel Inc.
2650 Decker Lake Blvd
Suite 300
Salt Lake City UT 84119
dennis.wanlass@am.dynonobel.com
(801)328-6526

Mr. Walter Wapman
Sandia National Laboratories
P.O. Box 5800
Albuquerque NM 87185-1007
wwapman@sandia.gov
(505)844-9761

Dr. Jerry Ward
DDESB
2461 Eisenhower Avenue
Room 856C, Hoffman Building I
Alexandria VA 22331-0600
jerry.ward@ddesb.osd.mil
(703)325-2525

Mr. Tim Wei
Spherical Precision, Inc.
2882-A Walnut Avenue
Tustin CA 92780
timwei@sphericalprecision.com
(714)544-7777

Mr. Paul West
Tooele Army Depot
1 Tooele Army Depot
Bldg. 1250
Tooele UT 84074-5003
paul.west@us.army.mil
(435)833-2621

Mr. Ronald Westmoreland
Tennessee Valley Authority
PO Box 1010
Reservation Rd., Ctr 2l
Muscle Shoals AL 35661
rawestmoreland@tva.gov
(256)386-2038

Mr. James Wheeler
Defense Ammunition Center
Attn: SJMAC-DO
1 C-Tree Rd Bldg. 35
McAlester OK 74501-9053
james.wheeler@dac.army.mil
(918)420-8901

Mr. Richard Whipple
Lawrence Livermore National
Laboratory
7000 East Avenue
Livermore CA 94550
whipple2@llnl.gov
(925)422-6314

Mr. William Whitcomb
Rock Island Arsenal
1 Rock Island Arsenal
Rock Island IL 61299-5000
whitcombw@ria.army.mil
(309)782-4349

Ms. Jana Whitelaw
U.S. Army Aberdeen Test Center
CSTE-DTC-AT-FP-A
Bldg. 400
APG MD 21005-5059
(410)278-0148

Mr. Philip Wichman
NSWC, Crane Division
Code 402, Bldg. 2540
Crane IN 47522-5001
(812)854-5583

Mr. Scott Willason
NAMSA
13, Rue De La Gere
Capellen 3302
LUXEMBOURG
swillason@namsa.nato.int
352 3063 6777

Mr. Aaron Williams
Defense Ammunition Center
1 C-Tree Rd
McAlester OK 74501-9002
aaron.williams@dac.army.mil
(918)420-8605

Mr. Barry Willmington
Defense Ammunition Center
1 C Tree Rd
McAlester OK 74501-9002
barry.willmington@us.army.mil
(918)420-8007

Mr. Kyle Willyard
Science Applications International
Corporation
RR 6 Box 28
Bloomfield IN 47424-0028
kyle.k.willyard@saic.com
(812)384-3587

Mr. Frank Winkler
EBV Explosives Environmental
Company
P.O. Box 1386
Joplin MO 64802
frank.winkler@ebveec.com
(417)624-0212

Mr. Richard Witiak
General Dynamics Corporation
11399 16th Ct. North
#200
Saint Petersburg FL 33716-2328
rbwitiak@stp.gd-ots.com
(813)578-8300

Mr. Scott Wohlenhaus
200th Material Management Center
ATTN: AERLA-MMC-MD
APO AE 09059
scott.wohlenhaus@us.army.mil
(314)484-8983

Mr. David Woodworth
Tooele Army Depot
Attn: SJMTE-CS-CO, Building 8
Tooele UT 84074-5001
waltersc@emh3.tooele.army.mil
(435)833-3240

Mr. Jeff Wright
U.S. Army AMRDEC
AMSRD-AMR-PS-S
Redstone Arsenal AL 35898
jeff.wright@amrdec.army.mil
(256)876-3150

Ms. Jaculine Wyka
Crane Army Ammunition Activity
300 Highway 361
Bldg 13
Attn: Brett Carroll
Crane IN 47522
jaculine.e.wyka@us.army.mil
(812)854-4163

Mr. Dennis Wynne
Battelle Memorial Institute
1204 Technology Dr
Aberdeen MD 21001-1228
wynned@battelle.org
(410)306-8614

Ms. Stacey Yauch
U.S. Army ARDEC
Building 321
Picatinny NJ 07806-5000
srego@pica.army.mil
(973)724-3290

Mr. Achim Zachow
Spreewerk Luebben
3550 General Atomics Ct.
San Diego CA 92121
garner@gat.com
(858)455-4497

Mr. Mark Zaugg
EBV Explosives Environmental Company
37 West 1400 South
Bountiful UT 84010
mark.zaugg@ebveec.com
(801)295-2003

Mr. Lin Zhi Yuan
Defence Science & Technology Agency
1 Depot Road #03-013
Singapore 106679
THAILAND
hliamchi@dsta.gov.sq
(656)373-2279

Mr. Dave Zoghby
EBV Explosives Environmental Company
7282 Flint Hill Road
New Tripoli PA 18066
dave.zoghby@ebveec.com
(610)298-3085

2006 Global Demil Symposium and Exhibition
Exhibits List

Anniston Defense Munitions Center
7 Frankford Ave
Anniston AL 36201-4199
(256)235-4310

Arctech, Inc.
14100 Park Meadow Drive
Chantilly VA 20151
(703)222-0280

ATK Thiokol
P.O. Box 707
Brigham City UT 84301-0707
(435)863-3020

Blue Grass Army Depot
2091 Kingston Hwy
Richmond KY 40475-5105
(859)779-6608

Bouldin & Lawson, LLC
PO Box 7177
McMinnville TN 37111
(931)668-4090

CH2M HILL
9189 S. Jamaica St.
Englewood CO 80112
(720)286-2327

Clean Harbors Environmental Services
200 Arbor Lake Dr
Columbia SC 29223
(803)691-3421

Crane Army Ammunition Activity
300 Highway 361
Crane IN 47522
(812)854-5455

Cybernet Systems Corporation
727 Airport Blvd.
Ann Arbor MI 48108
(734)668-2567

Defense Ammunition Center
1 C Tree Rd.
McAlester OK 74501
(918)420-8139

EBV Explosives Environmental Company
7282 Flint Hill Road
New Tripoli PA 18066
(610)298-3085

ECC
1240 Bayshore Hwy
Burlingame CA 94010
(650)347-1555 ext. 151

El Dorado Engineering, Inc.
2694 West 4700 South
Salt Lake City UT 84118
(801)966-8288

General Atomics
3550 General Atomics Ct.
San Diego CA 92121
(858)455-3951

General Dynamics-OTS
11399 16th Ct. North, Suite 200
St. Petersburg FL 33716
(727)578-8274

Gradient Technology
11080 Industrial Circle NW
Elk River MN 55330
(763)792-9990

Kobe Steel Ltd.
Iwaya-nakamachi 4 chrome 2-7
Kobe Japan 657-0845
81.78.261.7042

Lawrence Livermore National Laboratory
7000 East Avenue
Livermore CA 94550
(925)423-4681

McAlester Army Ammunition Plant
SJMMC-MO
1 C Tree Rd.
McAlester OK 74501
(918)420-6452

MSE Technology Applications, Inc.
200 Technology Way
Butte MT 59701
(406)494-7450

Nammo Demil Division
Vingåkersverken
Vingåker SWEEDEN 64392
+46 151 19518

NDCEE
100 CTC Drive
Johnstown PA 15904
(814)269-2870

NSWC Indian Head Division
101 Strauss Ave.
Indian Head MD 20640
(301)744-4279

NSWC, Crane Division
300 Highway 361
Code 4073, Bldg 2540
Crane IN 47522
(812)854-3505

PIKA International, inc.
12919 Southwest Freeway
Stafford TX 77477
(281)340-5525

Premier Technology, Inc.
170 E. Siphon Rd.
Pocatello ID 83202
(208)760-9193

QuantiTech, Inc.
300 Voyager Way
Huntsville AL 35806
(256)650-6263 x 206

Safety Management Services
1847 W. 9000 S
West Jordan UT 84088
(801)567-0456

SAIC
RR 6 Box 28
Bloomfield IN 47424
(812)384-3587 x207

Sandia National Laboratories
P.O. Box 5800
Albuquerque NM 87185-1007
(505)844-9761

Spreewerk Luebben
3550 General Atomics Ct.
San Diego CA 92121
(858)455-4497

Tooele Army Depot
1 Tooele Army Depot
Bldg 1
Tooele UT 84074-5003
(435)833-2694

TPL, Inc
3921 Acedemy Parkway North, NE
Albuquerque NM 87109
(505)344-6744

TRI-Rinse, Inc.
5200 Manchester
St. Louis MO 63110
(314)647-8338

University of Missouri-Rolla
1006 Kings Highway
Rolla MO 65409-0660
(573)341-4365

US Army ARDEC
Building 321
Picatinny NJ 07806-5000
(973)724-4122

UXB International, Inc.
1715 Pratt Dr.
Blacksburg VA 24060
(540)443-3742


2006 Global Demilitarization
Symposium & Exhibition
NDIA
Exhibit Hours
Monday, May 1, 2006 5:00 pm - 7:00 pm
Tuesday, May 2, 2006 9:00 am - 7:00 pm
Wednesday, May 3, 2006 9:00 am - 3:30 pm
CAAA/NSWC Crane Demil Tour
Friday, May 5, 2006 - Buses Depart the Westin Hotel Lobby at 6:15 am. You MUST be Registered for this event!
Badge Required for Entry
Must be 18 Years Old
No Photography
2006 Global Demilitarization Symposium & Exhibition
Break in Exhibit Hall
NDIA
Conference Hours
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Mr. Barry

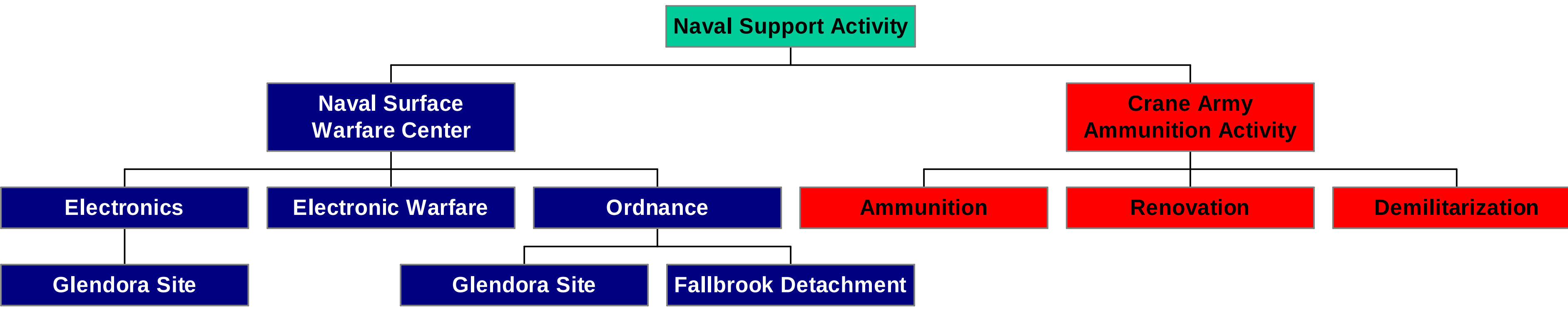
Team Crane

Welcome 2006 Global Demilitarization Symposium

2 May 2006

Team Crane

Mission Tenants of Naval Support Activity



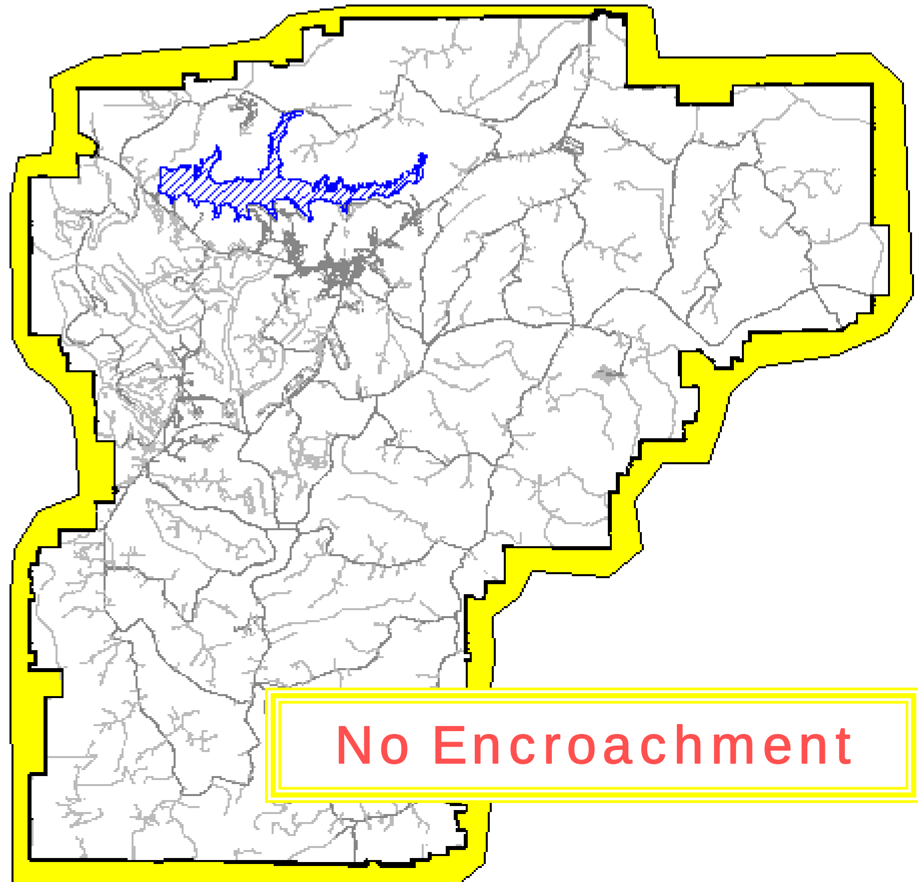
Other Tenants

Naval Sea Systems Command Product Area Director	FISC Norfolk Detachment Crane	Naval Facilities Engineering Command Midwest Detachment Crane	Explosive Ordnance Disposal Detachment
U.S. Coast Guard	Document Automation & Production Service	Industrial Hygiene	Naval Criminal Investigative Service
Defense Reutilization and Marketing Office	Defense Commissary Agency	Navy Exchange	

One Team for the Defense of the Nation

Crane Facts

- **Two Mission Commands**
  - **Crane Division, Naval Surface Warfare Center**
  - **Crane Army Ammunition Activity**
- **3rd Largest Navy Installation in the World**
  - 98 Sq Miles (approximately 64,000 Acres)
  - 3,000 Buildings
  - Facilities: $3B
    - Sq Feet built FY96-05 - 569,585
  - 650,000 Tons Ordnance Storage Capacity
- **No Encroachment**
- **Unencumbered**
  - 1,751 Total Buildable Acres (Crane Site)
  - Acres 690 Buildable Ordnance Area (Crane Site)
  - 98 Buildable Acres (Glendora Site (Sullivan Co.)
  - Environmental Compliance
- **3rd Largest Employer in SW IN**
- **2710 NSWC Crane Navy Employees**
  - 60% S&E/Tech
  - Average Age 45.5
- **652 Army Employees**
- **71% of Receipts to Commercial Sources**
- **> 900 Work Years of Contract Services**



NSWC Crane Mission

Provide engineering and industrial base support of weapon systems, subsystems, equipment, and components with principal emphasis on industrial and product engineering associated with surface warfare systems in the areas of electronics, ordnance, pyrotechnics, microwave technology, small arms, and surface ship electronic warfare in-service engineering.

Support to the Warfighter

Electronic Warfare - Electronics - Ordnance

- **Sustaining Systems**
- **Procuring Hardware**
- **Operations Support**
- **Inserting Technology into Critical Components**
- **Enhancing Fleet's Maintenance Capability**
- **Hardware Enhancements**

Joint Product Areas

One Team for the Defense of the Nation

Ordnance – Demil Support

Navy Demil Program Support (Code 4022)

- Program Management Support
- Designated Disposition Authority (DDA) Support
- Munitions Rule Support
- Ammunition Disposition Support
- Demil Plans – Review and approval
- Weapons Systems Explosive Safety Review Board (WSESRB) representative
- MIDAS Characterization

Demil Technology Development (Code 4073)

- Support PM Demil/U.S. Army Defense Ammunition Center (DAC)
- Serve on IPTs (Demil Strategic Planning, Demil R&D, Design for Demil)
- Develop/Demonstrate Safe and Environmentally Acceptable Demil Processes for Ammunition
- Collaboration with other Gov't Labs, Industry and Academia
- Work with DAC, JMC, Army Demil Sites to implement technologies

Thank you!

One Team for the Defense of the Nation

DEPARTMENT OF DEFENSE MERIT
Materials of Evolving Regulatory Interest Team

Emerging Contaminants Directorate

Emerging Contaminants: Strategic Priorities

Shannon Cunniff
Emerging Contaminants Directorate
Office of Deputy Under Secretary of Defense (Installations & Environment)

May 2006

What is an Emerging Contaminant?

Chemicals & materials

- **With:**
  - Perceived or real threat to human health or environment
  - Evolving regulatory interest
  - Either no peer reviewed health standard or an evolving standard
- **May have:**
  - Insufficient human health data/science
  - New detection limits
  - New exposure pathways

The Need for Action

Proactive vice Reactive

Early Emerging Contaminant Actions

- **Readiness Impacts**
- **Cleanup Costs**
- **Compliance Costs**
- **Health Claims**
- **Platform/Facilities Life Cycle Costs**

$$$

Small investment here

$$$

Large impact here

DoD Strategic Vision for ECs

- **Protect People & Enhance Readiness**
  - Ensure application of sound, thorough science in risk assessments
  - Make the process transparent and inclusive
  - Make sound risk management decisions on emerging contaminants

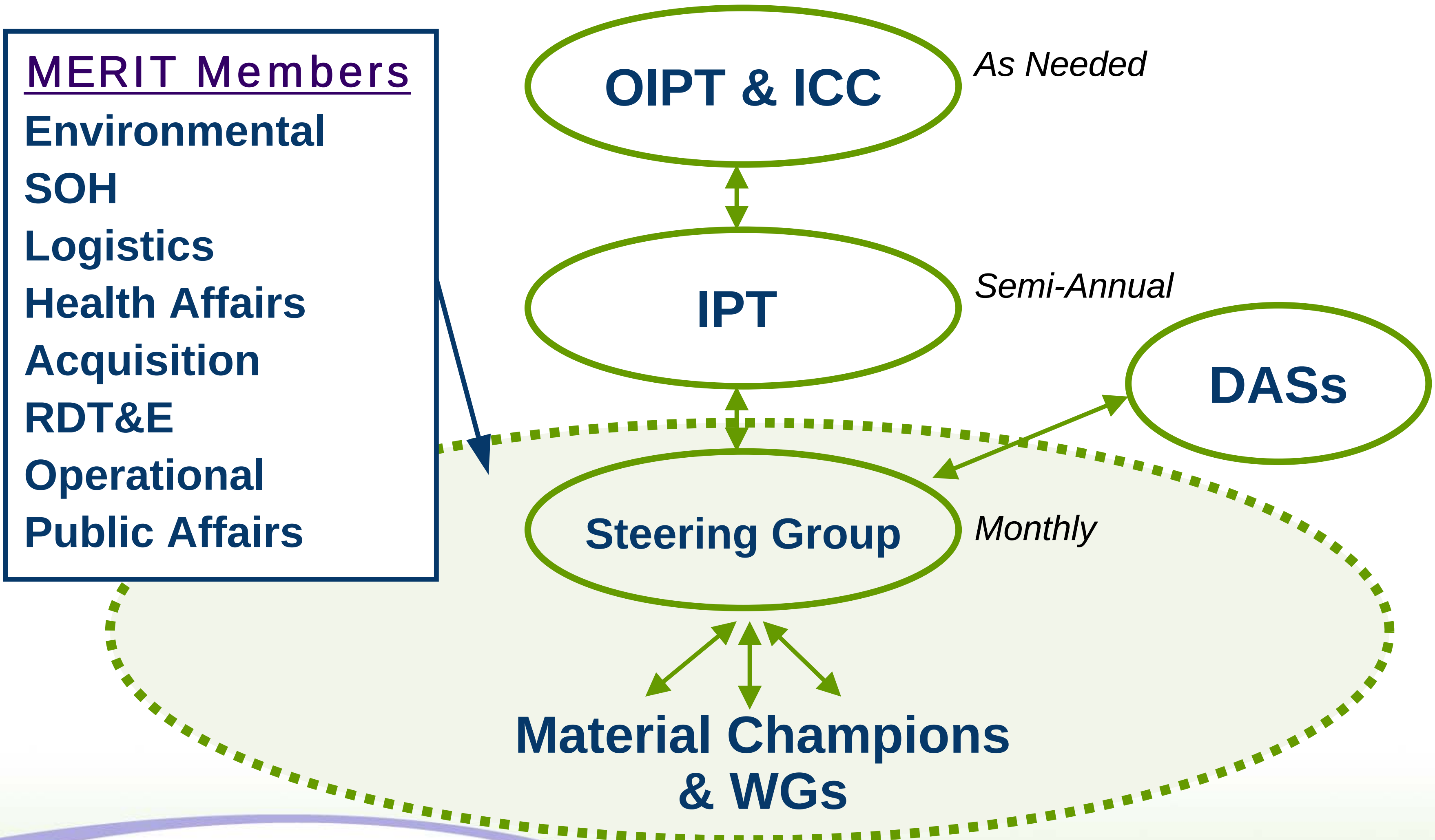
Strategic Priorities

- IRIS listing & risk assessments
- Better science
- Interagency involvement & transparency

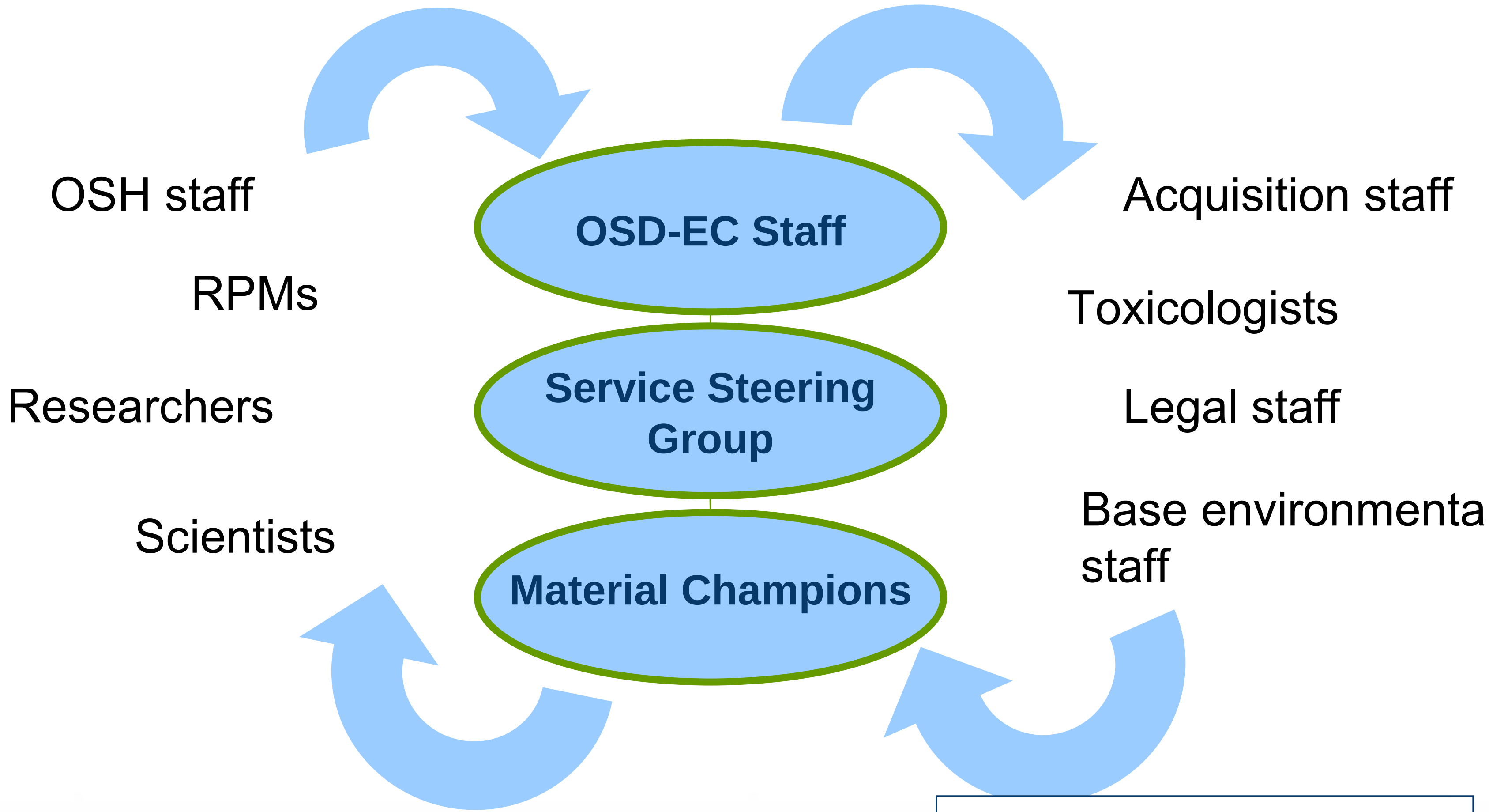
- DoD IPTs
- EPA, ATSDR, ECOS
- Industry Alliances

- Early warning & screening process
- Impact assessment
- Informed risk management actions

Vertical & Horizontal Integration



MERIT: The Virtual Team



Register to become a MERIT member at www.DoDMERITInfo.net

DEPARTMENT OF DEFENSE MERIT Materials of Evolving Regulatory Interest Team

Materials/EC Tracking Process

Over-the-Horizon Scanning

May be of interest

Watch List

Probable mission or budget impacts

Action List

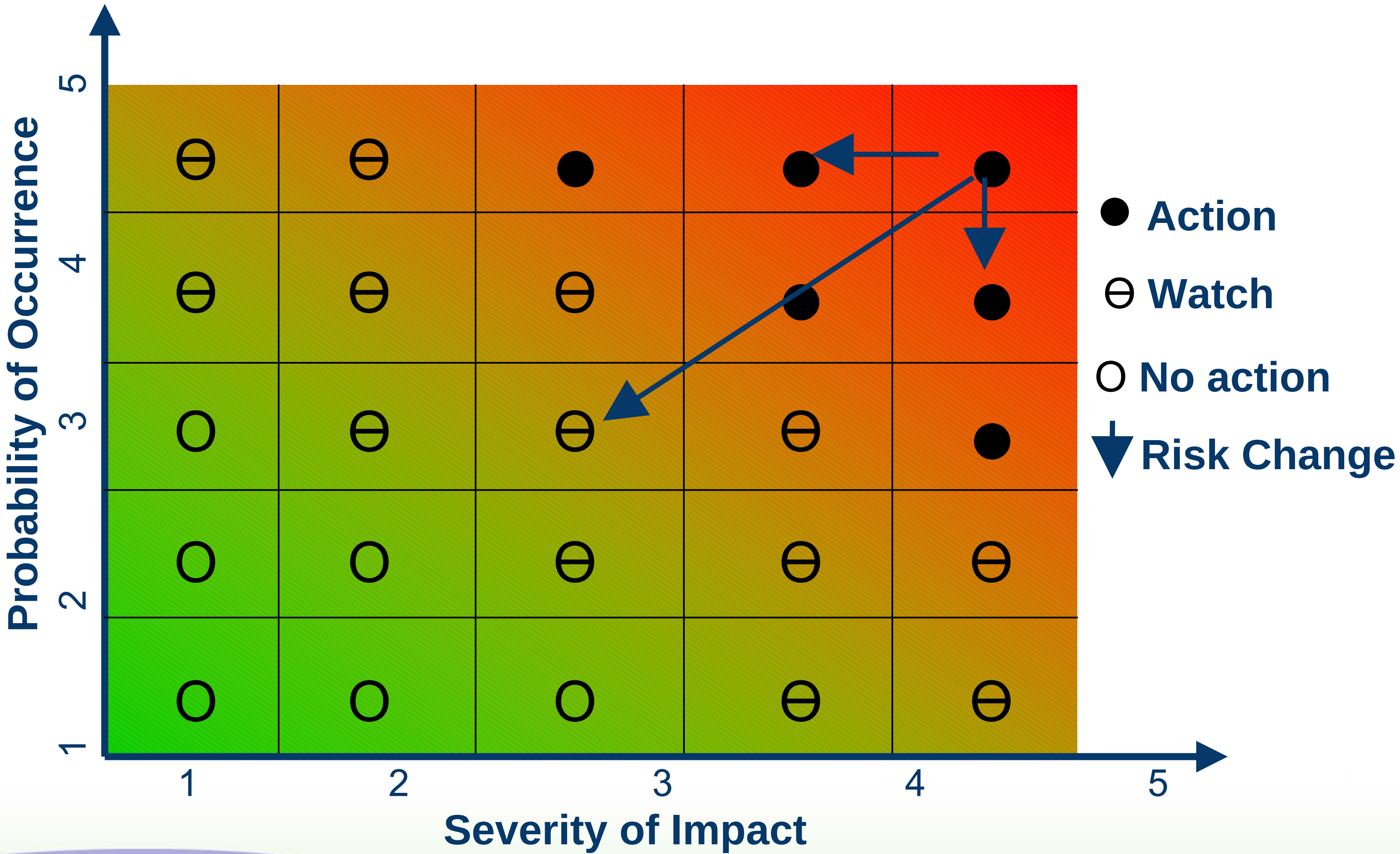
- **Material Champions Assigned**
- **Toxicological Research**
- **ID Other S&T Research Priorities**
- **Engage OMB/EPA/NIOSH/OSHA**
- **IPT decides risk management actions**

Review literature, periodicals, regulatory communications, etc.

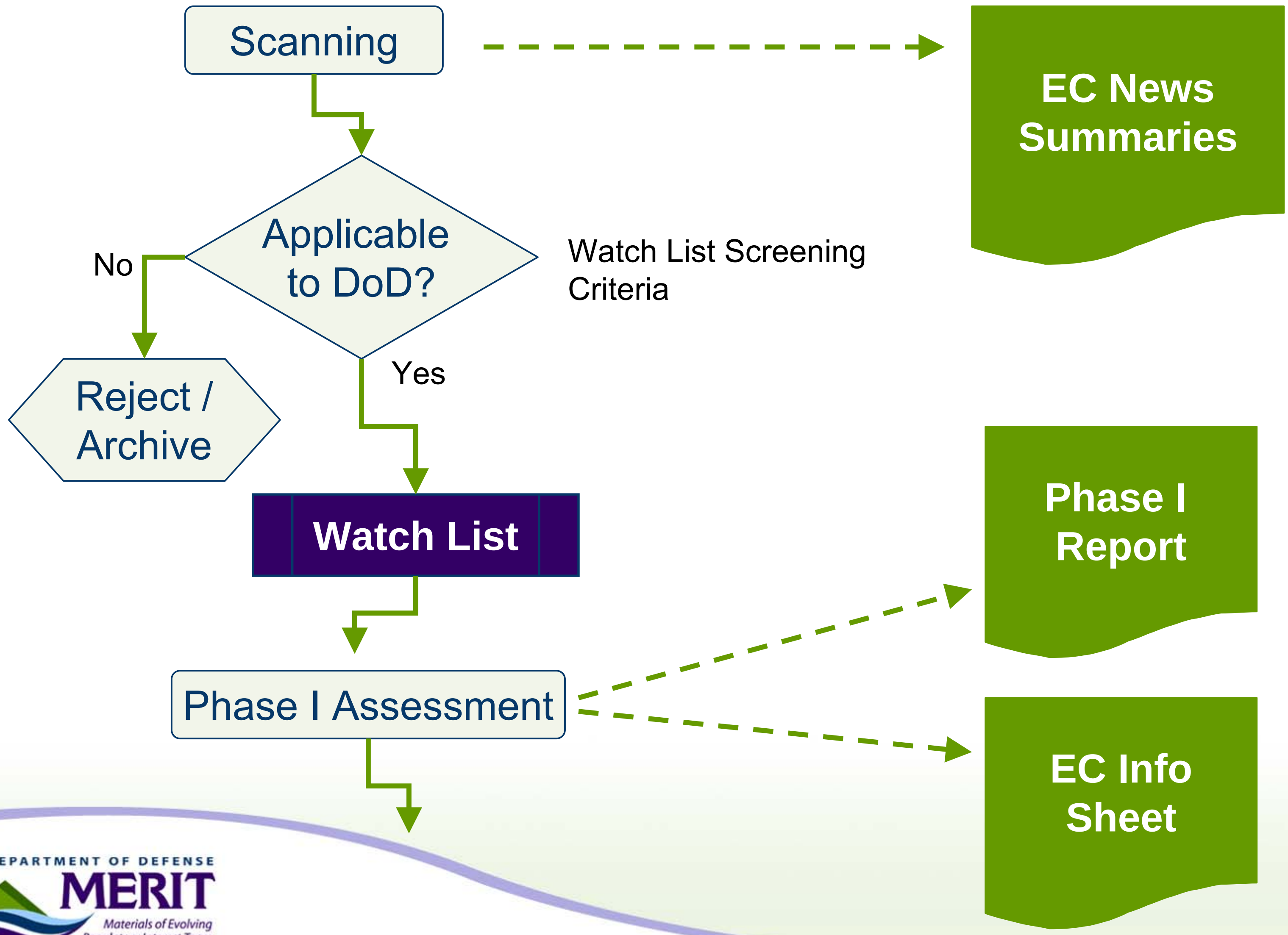
Monitor events; conduct rough impact analysis

Detailed impact analysis; launch risk management actions, including pollution prevention

Conceptual Risk Management Framework



EC Assessment Process - Part 1



Impact Assessment

Phase I: Initial Review

- Answers question: Should DoD be concerned?
- Starts with “Watch List”
- Requires limited resources
- Baselines Current Situation & Conducts Sensitivity Analysis
- Exit Criteria for going to Phase II
- Submit results to EC IPT/Steering Committee

Phase I EC Risk Summary

Probability of Regulatory/Political Actions
High, Medium, Low (H,M,L)

Probability

Impact Categories

Environment Safety & Health	Readiness & Training	Acquisition	O&M of DoD Assets	Cleanup
H	H	H	H	H
M	M	M	M	M
L	L	L	L	L

Severity

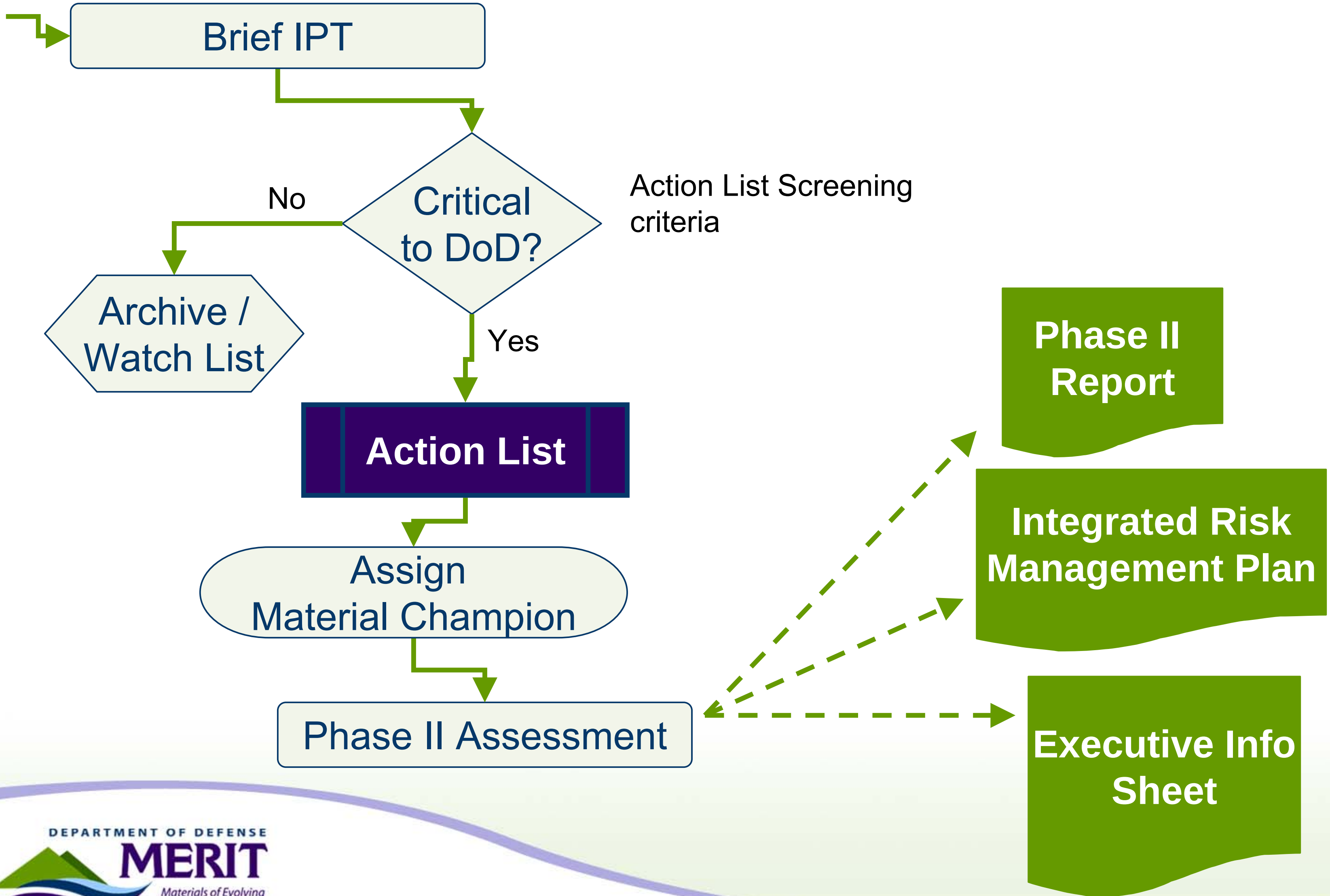
Overall Probability x Severity for each impact area = risk

Risk

Results:

- **Decision – Move to Action List?**
- **Initial Risk Management Actions**

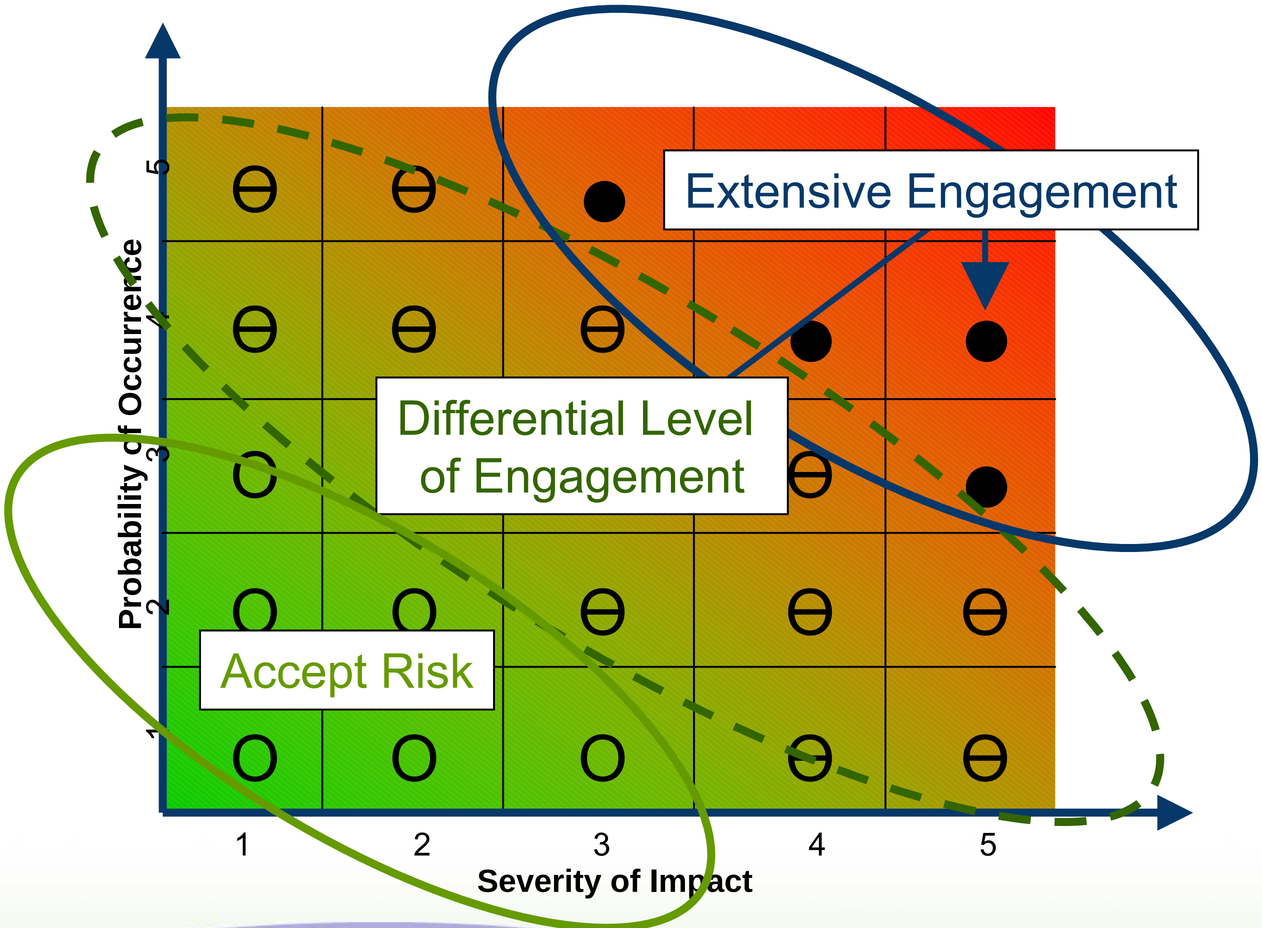
Assessment Process - Part 2



Impact Assessment

- **Phase II: Impact Assessment and Risk Management**
  - Answer questions: What is the impact? What can/should DoD do?
  - Starts with Action List
  - Requires greater resource allocation
  - Comprehensive study of impact areas
  - Integrated Risk Management Options
  - Economic Analysis
  - Recommendations

Integrated Risk Management Actions



- Fill science gaps
- Risk communication
- Material substitution
- Process changes
- Regulatory engagement
- Stockpile material
- Exposure assessment
- Increase compliance monitoring
- PPE upgrades
- RDT&E
- Acquisition changes
- Benchmark with industry
- Additional training

Differences – Watch & Action List

- Watch List
- May impact DoD
- Limited analysis of impact – more qualitative
- Monitor external actions
- Short info sheets developed
- Minimal resources expended

- Action List
- Likely to impact DoD
- Detailed analysis of impact – more quantitative
- Take RM actions
- Executive info sheets developed
- Significant resources may be expended
- "Material champion" assigned

EC Watch List

- Tungsten & alloys
- Tetrachloroethylene
- Dioxin
- N-nitrosodimethylamine (NDMA)
- 1,4-dioxane
- 1,2,3-trichloropropane (TCP)
- Nanomaterials
- Chromium VI
- Dichlorobenzenes
- Beryllium
- Polybrominated biphenyl ethers (PBDEs) and polybrominated biphenyls (PBBs)
- Di-nitrotoluenes (DNT)
- Naphthalene
- PFOAs

EC Action List

- **Perchlorate**
- **Royal Demolition eXplosive (RDX)**
  - Cyclotrimethylenetrinitramine
- **Trichloroethylene (TCE)**

RDX

- **Current toxicity values based on dated information.**
- **MMR - Total estimated costs for cleanup based on current IRIS toxicity value will total over $1Billion.**
- **DoD research aims to decrease uncertainty factors**
  - The toxicity values will be more accurate and less stringent values.
  - NEW COST EST?

DoD Perchlorate Guidances

- **Perchlorate Policy**
  - Based on EPA reference dose
  - Uses 24 ppb perchlorate in water as level of concern for management and cleanup decisions
  - Requires semi-annual wastewater effluent sampling at permitted DoD point sources where perchlorate has been used or released through dismantling of munitions
  - Directs assessment for off-range migration from operational ranges consistent with DoDD 4715.11 and 4715.12
- **Sampling Handbook**
  - DoD EDQW prepared
  - Available at www.DoDPerchlorateInfo.net

What's in the Future for Perchlorate ?

- **Regulatory Status**
  - State MCLs
  - Federal MCL? Still to be determined by EPA
  - OB/OD permitting
  - Groundwater antidegradation issues
- **State of the Science**
  - Continuing Tox and Epi work
  - Looking at Dietary Sources
- **Nature and Extent**
  - New info monthly on potential sources
- **Pollution Prevention**
  - Reclaim, Recycle, Reuse
  - Substitutes

Energetics of the Future

- **Track environmental feasibility with energetic feasibility**
  - To predict chemical & physical characteristics
  - To predict environmental effects
    - » Human health
    - » Fate, transport and effects
  - To make informed risk management decisions

Summary

- **EC management requires new thinking**
  - Proactive vice reactive
  - Investments before regulatory action

- **Potential large payback**
  - Protects people, mission and assets

Join MERIT today!

www.DoDMERITinfo.net

Demilitarization Outlook

LTC Brian Raftery
PM, Demil
DSN 880-5276
brian.raftery@us.army.mil

May 2006

Today's Environment

- **We are at war**
- **The Army has a lot of bills to pay**
- **Demil is constantly viewed as a bill payer**
  - ✓ **The value of demil is hard to quantify as are the operational impacts of the stockpile on the depot mission**
  - ✓ **Extended storage is an attractive alternative to demilling in terms of cost**
  - ✓ **The intrinsic value of demil to the warfighter is hard to quantify**
- **We need to protect the funding we have and execute it; if we don't someone else will**

Storage Capacity

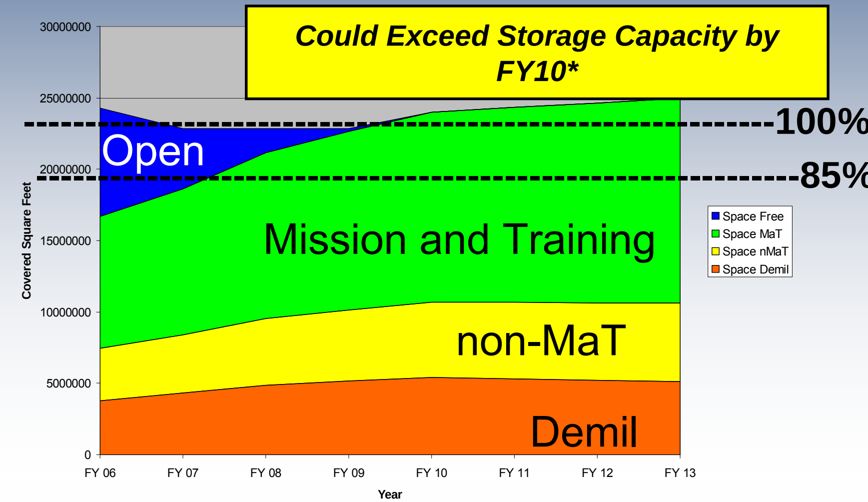
Background

CONUS	Stockage Objective (tons)	Current (tons)	%
MaT* capacity	TBD	1152K	TBD
nMaT capacity	TBD	449K	TBD
Demil capacity	100K	441K	441%
Total:		2042K	

- BRAC RRMC (FY06): 36K tons - 6% loss in overall storage capacity
- OCONUS Retrograde (FY08): ~40k tons/year

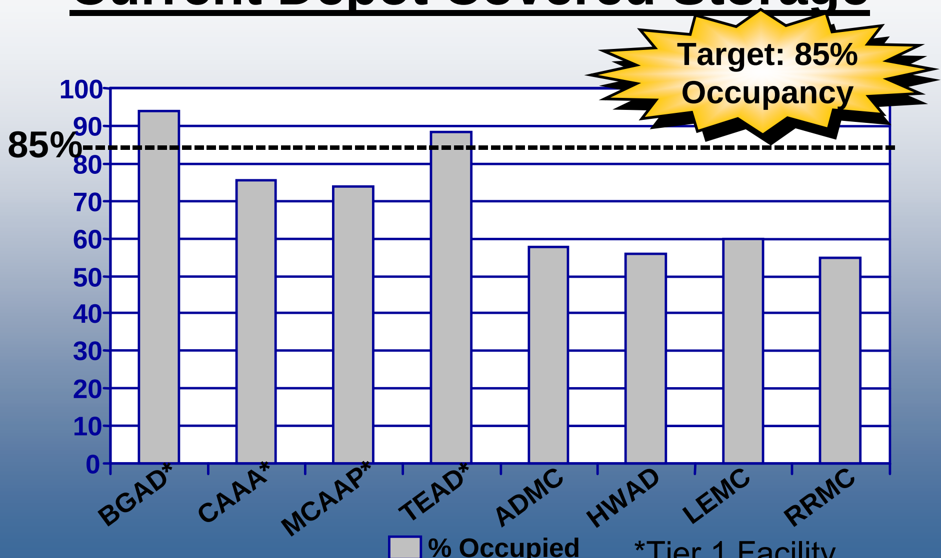
*Mission and Training stocks

Depot Occupancy Profile Projection



* Assuming 5 Retrograde Ships/Year

Current Depot Covered Storage

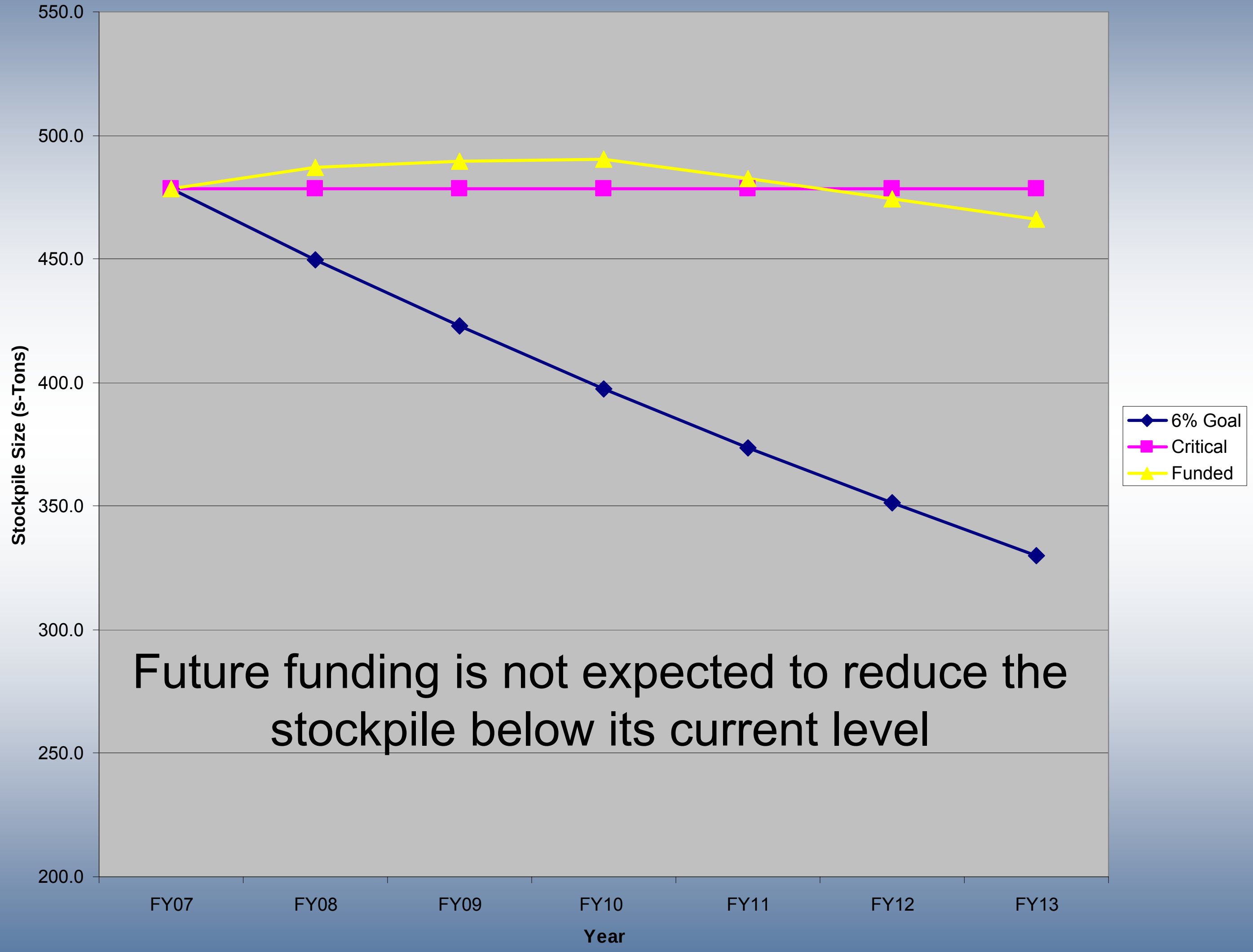


*Tier 1 Facility

Analysis

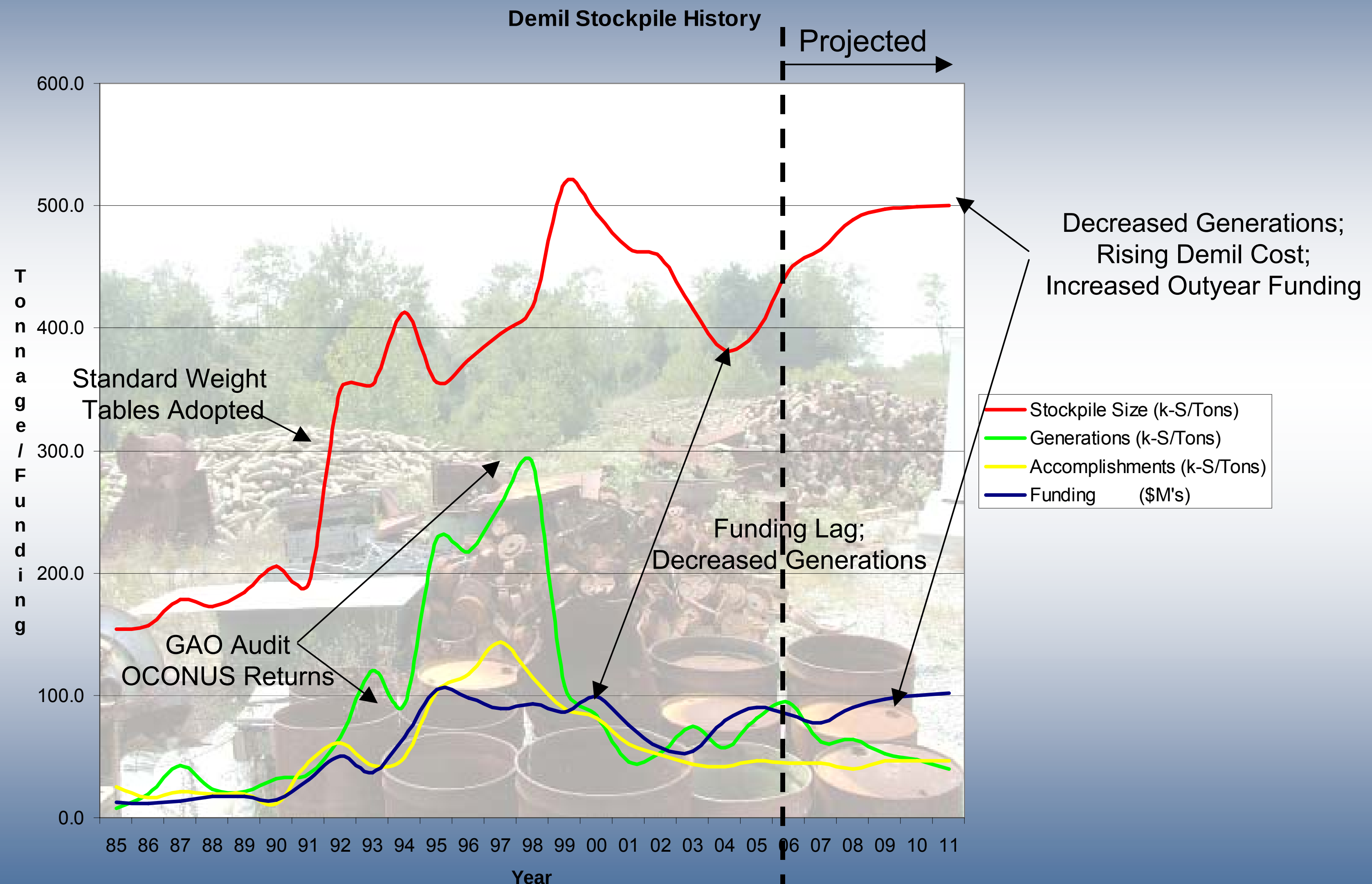
- Sufficient capacity to meet war time stockage objectives
  - FY08: exceed 85% maximum target ceiling
  - FY10: exceed 100% of storage capacity
- Demil will grow from 447K tons (FY05) to 490K tons (FY09)
- FY05: 46% of stocks - non-mission and training and Demil; they are stored alongside and amongst MaT stocks
- Already allocating more sq feet/ton than desired (8.12 vs 7 sq ft/ton)
- Just to keep pace with generations requires funding of $103M/year - currently funded: $95M/yr
- Existing storage space is not homogeneous, it is in “holes” amongst the composite stocks

Demil Funding Impact



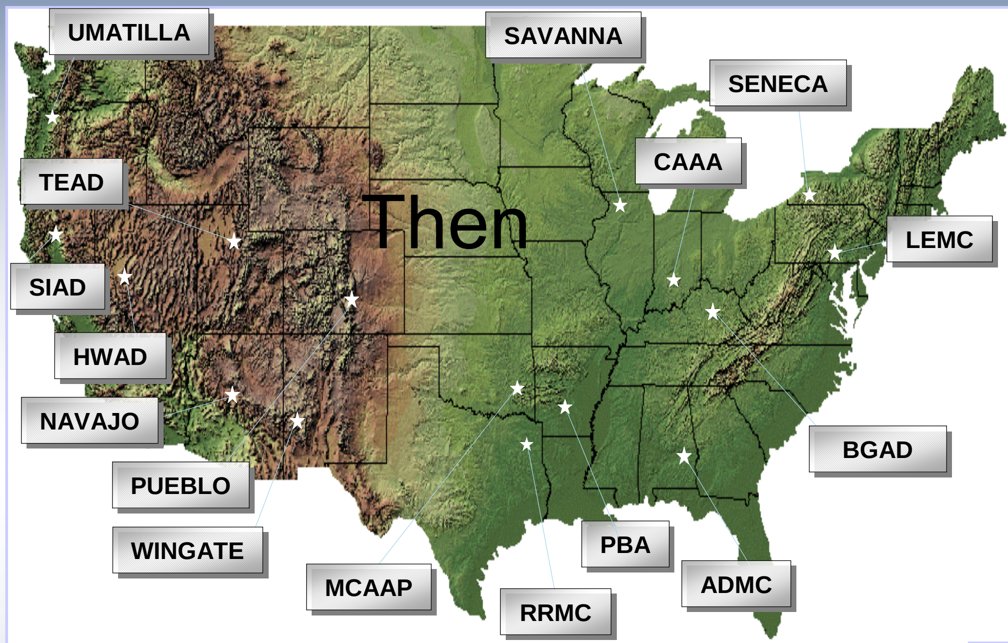
Based on PresBud FY07 and Forecasted Generations

Demil Stockpile: 25 Years of Growth



We've been "kicking the can" down the road since tracking began…

BRAC Impact



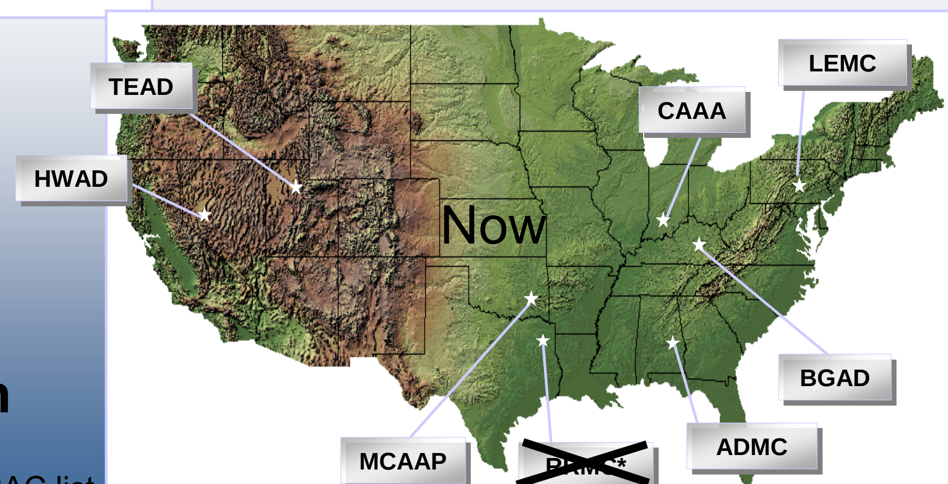
1990-
Tonnage: 2.6M
Sq Ft: 40M
 # Sites: 16
Density: 15.4 ft²/ton

Since 1990 we have lost 40% of our storage capacity; stored stockpile has only decreased by 15%

BRAC directed closures will fill MCAAP to 98%

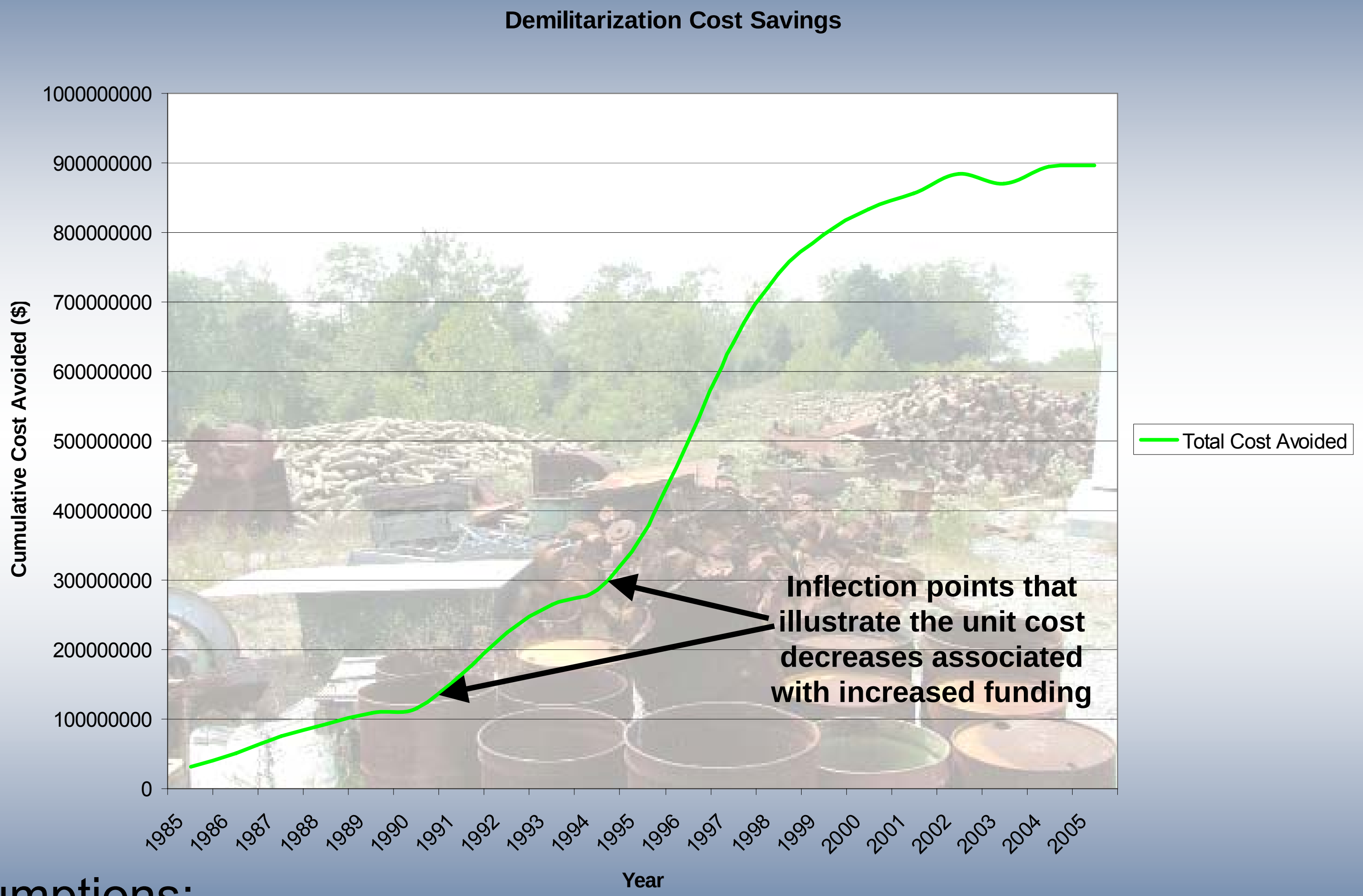
Our actual storage density is converging on our available storage density- the margin for error is disappearing

2005-
Tonnage: 2.2M
Sq Ft: 24M
 # Sites: 8
Density: 11 ft²/ton



*RRMC on 2005 BRAC list

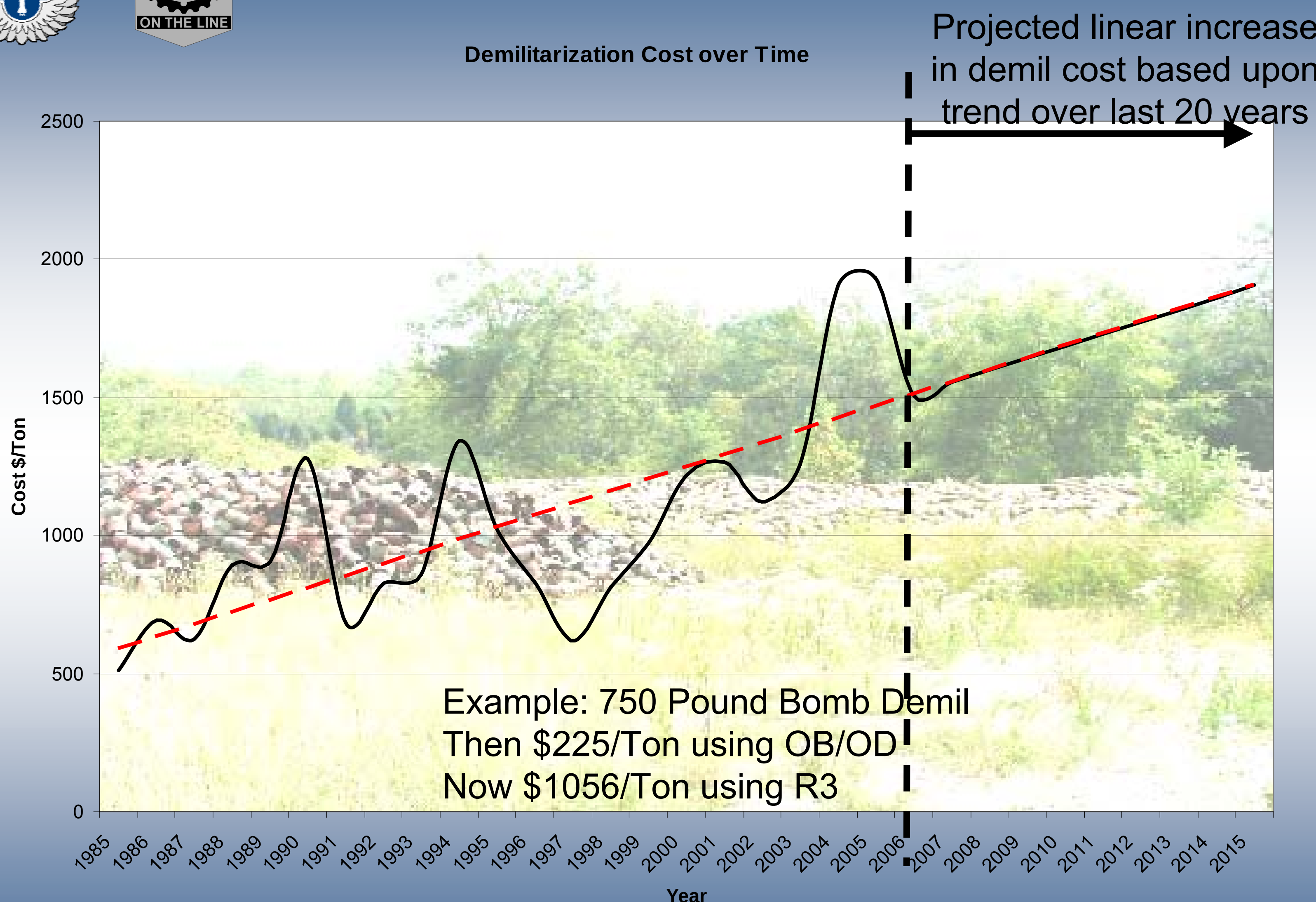
Accomplishments: Demil Avoided Costs



Assumptions:

- Storage costs of demilled stocks are avoided in future years
- Higher future cost of demil is avoided in future years

Cost of Demil

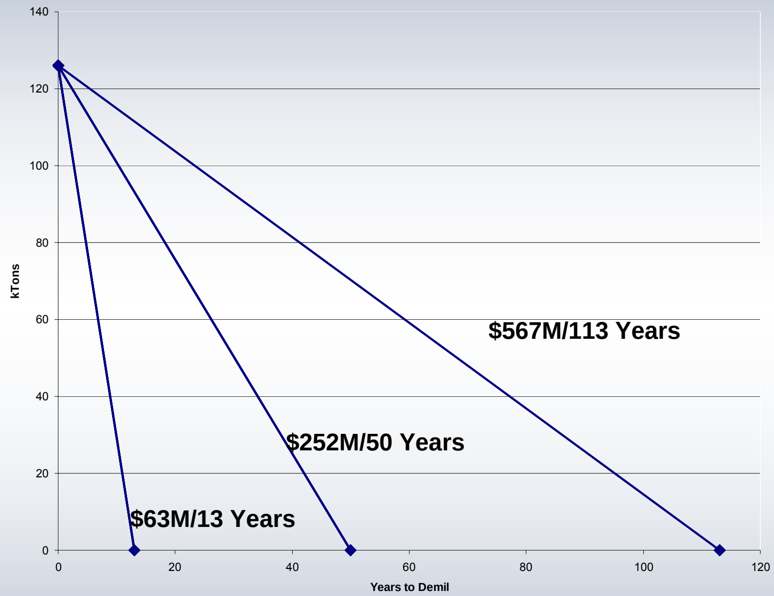


General Trend: Big bang, small buck to no bang, big buck-
Deferring demil will cause us to pay more and get less tomorrow

Effect of the Rising Cost of Demil

- **Crane Army Ammunition Activity (CAAA) has a demil stockpile of 126,000 tons; every year it costs $5M just to inventory and maintain it**
  - ✓ **If we invested that $5M on demilitarization every year starting back in 1985, CAAA's demil stockpile would have been gone in 1998 for a total cost of about half the current demilitarization budget ($63M)**
  - ✓ **If we started today with $5M/year it will take 50 years and about twice the annual demil budget ($252M)**
  - ✓ **If we wait those 50 years and start in 2056 it will take about 113 years and almost five times the annual demil budget ($567M) to get rid of the same 126,000 ton stockpile**

Drawdown Profiles @ $5M/Year:



- Assumes $4500/Ton cost of demil in 2055
- Assumes Actual Cost of demil in 1998 and 2005

The cost of lost opportunity is growing as we sink resources into storing junk

SO WHAT?

- Fact: Non mission and training (MaT) stocks impede the depots' wartime support mission
  - They reduce outload efficiency (industry cases show potential efficiency increases of 25-65% and capacity increases of 35-40% in warehousing/ shipping operations*)
  - They force depots to store new production in less than optimal locations
  - They cause less than optimal storage workarounds
- Fact: As storage capacity is filled, it becomes harder to make it more efficient
- Fact: Demil is the only storage solution that creates space; all others utilize existing space more efficiently
- Fact: Tomorrow's demil methods will cost more
- Assumption: Brigade Combat Team (BCT) configured loads positioned for optimum response will need more space than homogeneous lots
  - A Ranger Battalion basic load weighs 64 short tons and occupies 6000 sq. ft. resulting in a density factor of 93.8; planning factor for conventional ammunition is 7 - an order of magnitude increase

* Source: Operational Concepts, Inc. recent projects case studies

SO WHAT?

- Assumption: Modeling and Simulation indicate that we could achieve a potential time savings on the order of 30% in the outloading of MaT ammunition as well as a 30% reduction in the number of “touches”
- Assumption: We don’t know exactly how inefficient we are; how efficient could we be if we removed 46% of “junk” stocks?
- Fact: Outdoor storage is not a desired option
  - ✓ It costs: moving stocks within a depot costs approximately $53/ton
  - ✓ Outdoor storage introduces security, environmental, deterioration, and safety issues

- The depots are accomplishing their mission; demil and other non-MaT stocks make it harder and more expensive -

Other Considerations

- **If funded, we can execute:**
  - ✓ **We have capacity right now at depots**
  - ✓ **We can increase our commercial workload**
  - ✓ **We can demil overseas**

- **Stockpile reduction is a function of funding**
- **The cost of shipping stocks to remote storage (inter-depot) and back can actually exceed the cost of demilitarizing them**

“Out of the Box” Initiatives

- We are looking for non-traditional solutions to reduce the demil stockpile; potential examples:
  - ✓ Foreign Military Sales
  - ✓ Domestic and Foreign Industry
  - ✓ Training
  - ✓ Entertainment
- We will be seeking ideas from any interested party (initially through Request for White Paper)
- We are not looking for traditional execution capability or new technologies
- A side bar is planned to entertain potential initiatives at this symposium (Wednesday, 1500, Rm 204)

Commercial Ammunition Demilitarization Contract (CADC)

- This chart intentionally left blank

Summary

- We are facing the challenge of a growing demil stockpile in a fiscally constrained environment
- We must operate efficiently and execute quickly to maximize the effectiveness of our resources
- Demil has the potential to create operational efficiencies, however we must make an investment to do so
- We are pursuing non-traditional means of stockpile reduction to maximize the impact of funding received

REPORT ON ICAP

BY: RALPH HAYES

EL DORADO ENGINEERING, INC.

WHAT IS ICAP?

- INDUSTRIAL COMMITTEE OF AMMUNITION PRODUCERS
- SECTOR
  - DEMILITARIZATION
  - FUZES/TIMERS
  - GOCOs
  - LARGE CALIBER/BOMBS
  - PROPELLANTS AND EXPLOSIVES
  - PYROTECHNICS
  - SMALL/MEDIUM CALIBER
  - SYSTEMS, ELECTRONICS AND SENSORS
  - WARHEADS AND ROCKETS

ISSUES/THRUSTS FOR 2006-GENERAL IZZO

- BRAC
- INSENSITIVE MUNITIONS
- DEMIL – STORAGE VS. FUNDING RECOGNITION
- DEMIL – CAN ITEMS BE SOLD?
- INDUSTRIAL BASE – PLEASED WITH ATTITUDE3

OTHER TOPICS

- ARMS PROGRAM
- CRITICAL CHARACTERISTICS CLAUSE
- BRAC IMPLEMENTATION PLANNING
- SECTOR REPORTS

WHAT ARE OUR DEMIL ISSUES FOR ICAP

Demil Execution

Lou Ligeno
Chief, Demil & APE Management Division
Munitions & Logistics Readiness Center
DSN 793-8583/COMM 309-782-8583
Email lou.ligeno@us.army.mil

ON THE LINE

JMC – On the Line

Stockpile Status

- ✓ As of the end of March, 2006
  - ➢ Demil stockpile is 442,809 tons
  - ➢ Generations are 19,418 tons
  - ➢ Accomplishments are 9,767 tons
- ✓ Largest percentage of the stockpile is stored at HWAD (29%)
- ✓ Largest percentage of the stockpile is in MIDAS family HIIM, 155mm M483 ICM Projectiles (D563) (9.4%)

Organic Demil Status

- ✓ FY06 funding received on 26 Feb 06 with nearly 5 months of the Fiscal Year gone
- ✓ Accomplishments are 120% of schedule
- ✓ The Organic Program is ahead of schedule in spite of late receipt of funding –

Thanks! Great Job!

Commercial Demil Status

Stop Work Order still in effect

Looking Forward
Our Challenges and Opportunities

- ✓ **Bottom Line Up Front: The Demil Stockpile will continue to grow, funding will not be available to stop this trend in the near future.**
- ✓ **How do we maximize the positive impact of our limited funding?**

Maximize Positive Impact on Storage Space

- ✓ Storage is reaching a critical level, estimated to be over 100% full by FY10/11
- ✓ Installations have been requested to identify alternative demil projects for execution in FY07 that maximize storage space freed up
- ✓ Storage space freed is reported by installations on their monthly metrics
- ✓ Effort increases out loading efficiencies, a direct impact to the war fighter

Maximize Positive Impact on BRAC Requirements

- ✓ Demil as much as possible on site before transfer of mission
- ✓ Transfer stocks to site with demil capability
- ✓ Minimize handling and transport requirement of demil stocks in support of BRAC

Maximize Positive Impact of Demil as a Source of Supply

- ✓ Continue to assign priority to projects that generate components for reuse
  - ➢ Packaging material for 120mm tank rounds
  - ➢ Supplemental charges
- ✓ Scrub the demil account for components/materials that could be recovered from assets and reused
- ✓ Continue to characterize munitions to facilitate reuse initiatives

On The Horizon

- ✓ Increasing funding constraints
- ✓ Demil Initiatives Study Team
- ✓ Scrap proceeds legislation making its way through the political process

John L. Byrd, Jr. Excellence in Munitions Demilitarization Award

1995 John L Byrd, Jr.
Defense Ammunition Center

1996 Larry "Mort" Mortenesen
Day & Zimmermann Hawthorne Corp.

1997 LtCol James Humphrey
Industrial Operations Command

1998 Karlene Priest
Crane Army Ammunition Activity

1999 William Munson
Thiokol Propulsion

2000 Capt David Wallace
DoD Explosive Safety Board

2001 Richard Fuller
Operations Support Command

2002 Kathy George-Reading
Operations Support Command

2003 John McCoy
HQ Army Materiel Command

2004 Dan Burch
NSWC Crane

2005 Curtis Anderson, Jr.
ARDEC

2006 Randall Burcham
Crane Army Ammunition Activity

2006 John L. Byrd, Jr. Excellence in Munitions Demilitarization Award Recipient

Mr. Randall Burcham

Crane Army Ammunition Activity

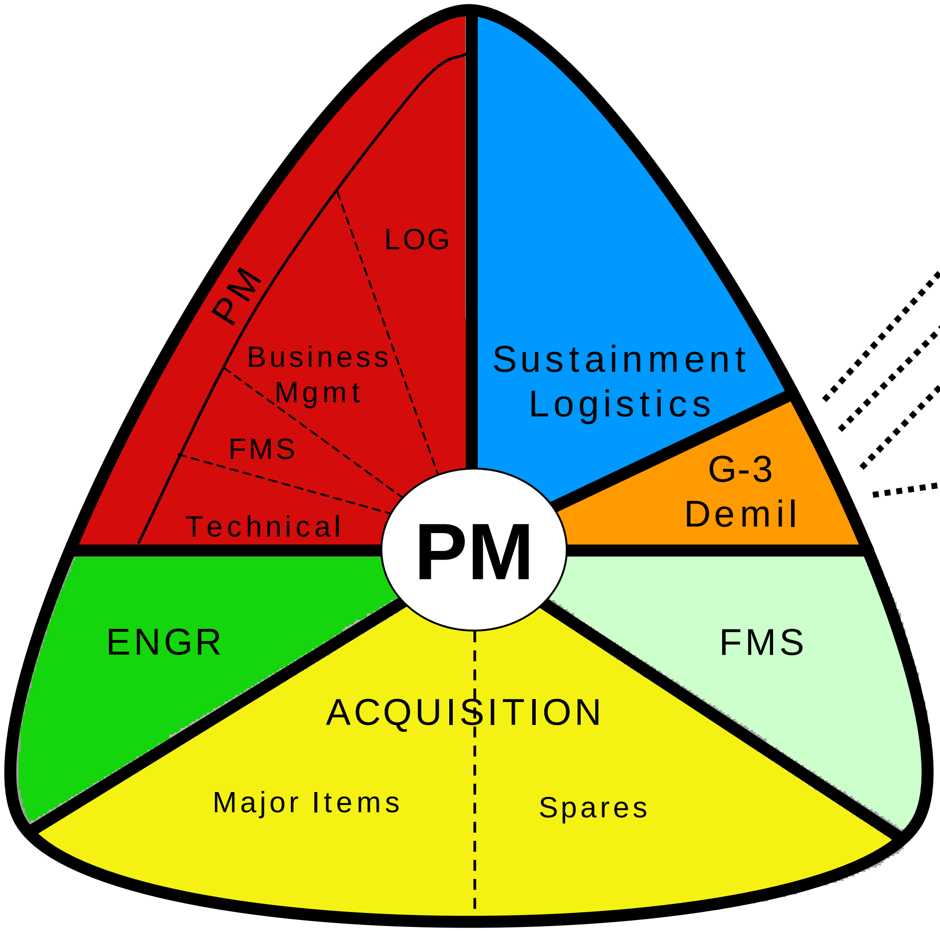
AMCOM G-3
US Army Missile Demil Program

Global Demil Symposium

2 May 2006

Soldier Focused Life Cycle Management (SFL)

"A Team Redstone Initiative"



- PM Demil
- AMRDEC
- Defense Ammunitions Center (DAC)
- Munitions Centers

Missile Demil Life Cycle Management

Mission: **Cost Effectively Demilitarize Excess, Obsolete, and Unserviceable Army Missiles with Minimal Environmental Impact Utilizing Resource, Recovery, and Recycling (R3) Methods to the Greatest Extent Possible**

PEO Missiles and Space PMOs

- Design for Demil
- Identify Demil Alternatives
  - SLEP / Remanufacture
  - Reuse
  - FMS
  - Training
- Participate on Demil IPT
  - Identify Requirements
  - Integrate Into Acquisition Strategy

AMCOM G-3

- Develop Execution Strategies
- Integrate / Prioritize
- Develop Funding Requirements
- Execute

Army Tactical Missile Systems

- Requirements Thru 2013 -

TOW

111,439

HELLFIRE

27,633

ATACMS

1,976

MLRS

208,306

HAWK

6,198

Javelin

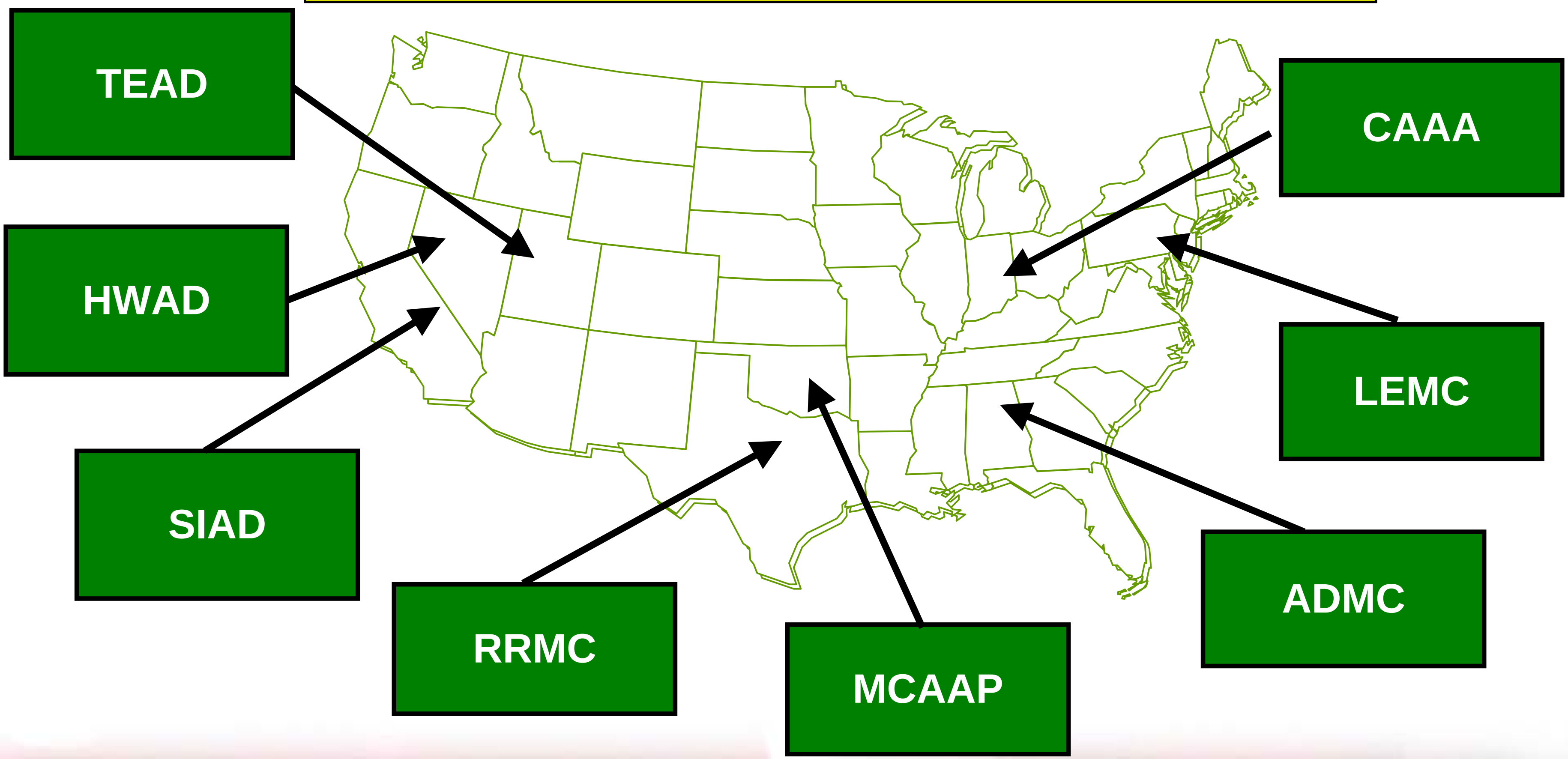
1,559

PATRIOT

1,895

Aging Stockpile
Creates a Nationwide Challenge

- **Over 150K Missiles & Components Obsolete or Excess Today**
- **Current Projections Double That Number by 2015**
- **What is the Most Cost Effective Plan of Attack?**



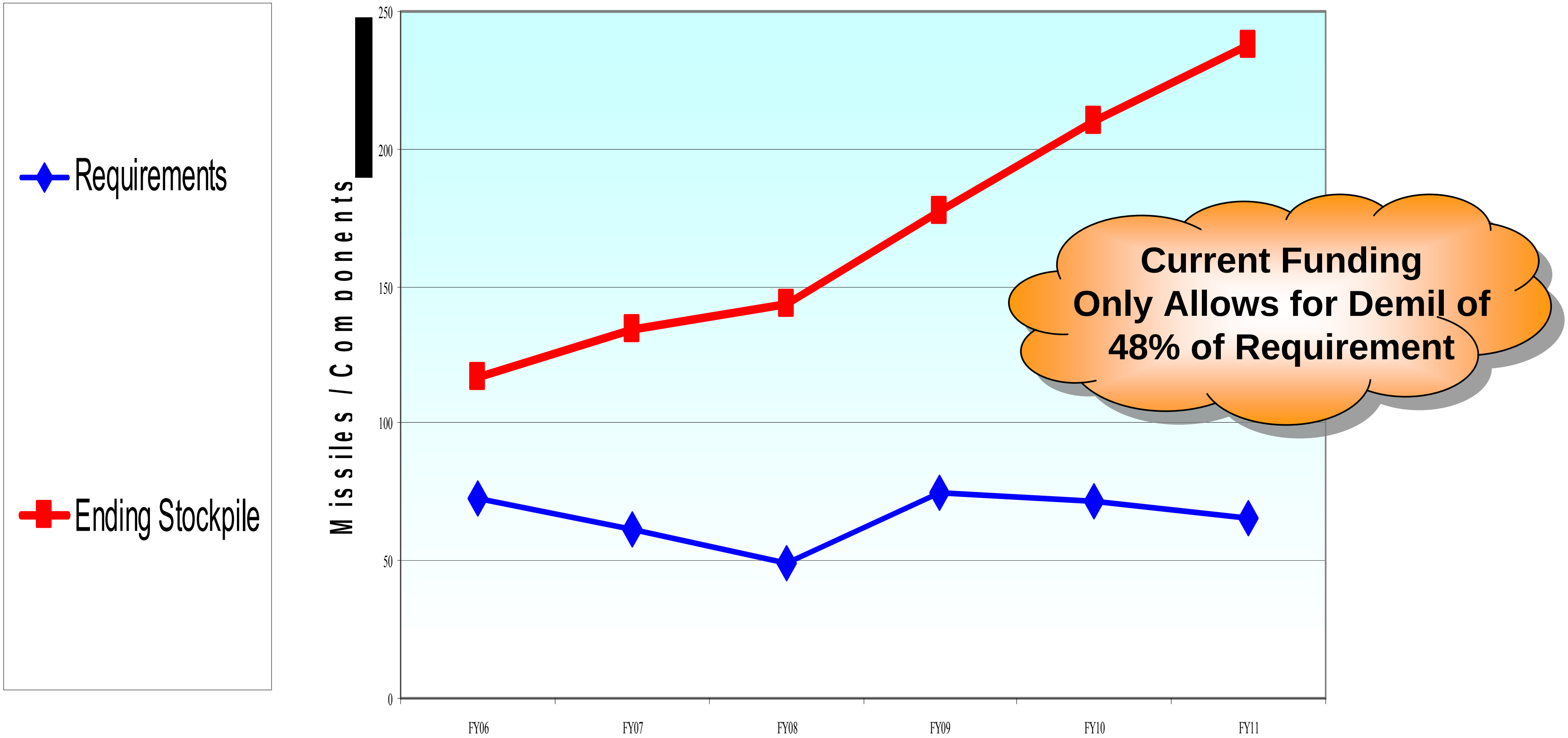
Attacking the Stockpile

AMCOM Execution Strategy

- Demil Small Quantity/Low Value Systems by Open Burn/Open Detonation (OB/OD)
- Closed Disposal/Resource Recovery and Recycling (R3) of TOW Missiles Utilizing the Missile Recycling Center
- Identify Additional Closed Disposal/R3 Technology Alternatives for "Full Rate Demil"
  - Flexible for Multiple Variants
  - Adequate Throughput
  - Forward Looking – Anticipates Environmental Issues

Tactical Missile Demil Funding

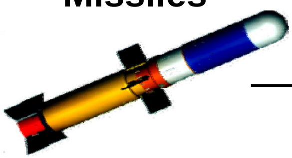
Missile Demil Requirements



Cost Effective Processes & Technologies Are the Priority

Anniston Defense Munitions Center
Missile Recycling Center (MRC)

TOW Missiles



Building 381

Horizontal Disassembly Module

Disassemble, Missile, Motor Propellants Removal / Milling, Warhead Removal / Milling

Low Value Energetics

High Value Energetics

Building 65

Slurry Explosive Module

Process Low Value Energetics Into Commercial Blasting Explosives

Energetics Processing Module

Energetics Processing Module (FY07)

Recover High Value Energetics From Propellant and Warhead Feedstocks

Missile Components

Hardware Decontamination Module

Decontaminates Hardware Components

Recycle/ Reuse

Missile Recycling Center Capability

- **Missile Recycling Center (MRC) Provides Environmentally Superior Alternative to Traditional Destruction Processes**
  - **Encompasses Entire Missile**
  - **Reconstitutes Propellant and Warhead Energetics**
  - **Maximizes Reuse/Recycle of Recovered Material**
- **MRC Cumulative Accomplishments to Date**
  - **32,360 Missiles Disassembled**
  - **267,618 lbs of Energetics Prepared for Final Processing**
  - **701,060 lbs of Scrap Metal Recycled**
- **Fully Operational by 2QFY07**

Areas of Concern

- **The Future of Ammonium Perchlorate**
  - Regulations Are Getting Tighter
  - MLRS Stockpile at ADMC Alone Will Create Over 8,000 Tons of AP
  - Initial Planning Called for Reuse of Material – Will This Still Be Valid?
  - If Not, What Are the Alternatives?
- **What Additional Compounds Will We Produce That Are an Environmental Concern**
- **Developing Flexible Processes, Tooling and Facilities**
  - AMCOM Currently Responsible for 20 Different Missile Systems & Variants
  - Too Costly to Development "One Off" Solutions for Each
  - Must Be Able to Adapt to Newly Developed and Evolving Systems

Path Ahead

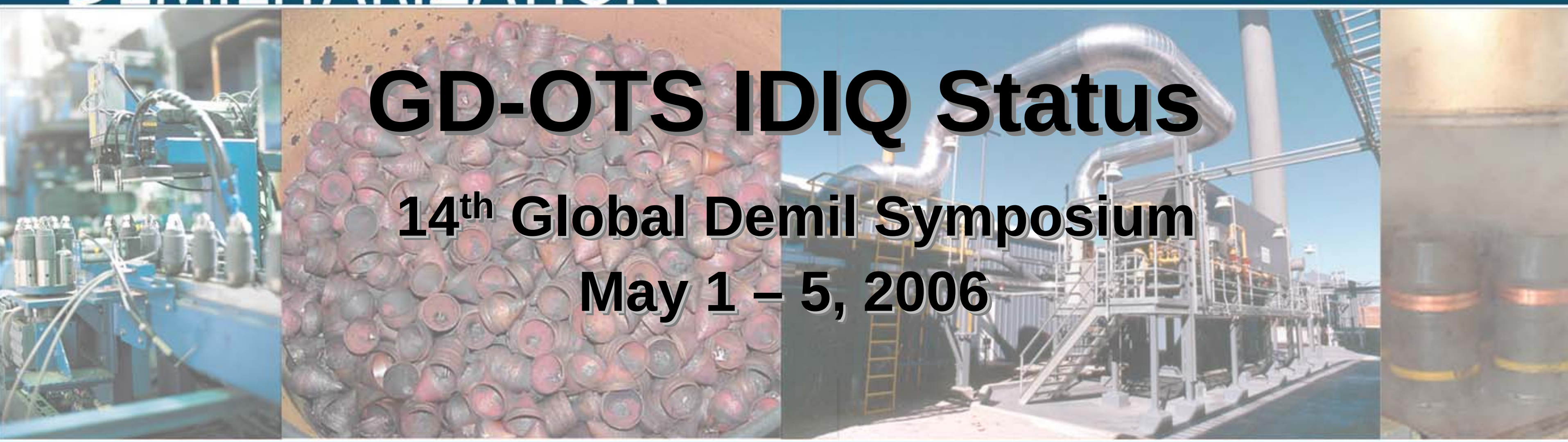
- Continue Execution of Environmentally Responsible Demilitarization Program
- Emphasize Closed Disposal/R3 Technologies
- Focus on Demilitarization Options That Can Be Utilized Across All Families of Missiles
- Maximize Return on Investment/Reduce Per Missile Costs

Questions?

GENERAL DYNAMICS
Ordnance and Tactical Systems

14th Global Demil Symposium
May 1 – 5, 2006

DEMILITARIZATION



GD-OTS IDIQ Status

14th Global Demil Symposium
May 1 – 5, 2006

Wilfried Meyer
Demil Program Manager
727-578-8304
wmeyer@gd-ots.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

Status IDIQ Contract Demilitarization

- **GD-OTS Commercial Demil Prime Contractor to JMC**
- **Demilitarization of nine Families of Conventional Ammunition from 1999 to Oct 2005**
- **Used only Safe, Environmentally Friendly and Effective Technologies for Resource Recovery and Recycling (R^3)**
- **All Demil processing were performed at ISO 9000:2000 Certified or Compliant Demil Facilities**
- **More than $10 Million of facility work completed during IDIQ to install new facilities and production lines**
- **Established base of qualified and highly skilled demilitarization personnel and subcontractors**

GD-OTS provided Turn-Key Demilitarization to Demil Customer

Total Ammunition Processed

13.43 Million Units / 43,969 Tons

Small Caliber:

6,423,430 Rounds

3,409 Tons

Explosive D:

59,590 Rounds

5,732 Tons

ICM's:

98,001 Rounds

5,353 Tons

Fuzes:

1,361,933 Rounds

3,358 Tons

Pyrotechnics:

437,445 Rounds

2,478 Tons

Propelling Charges:

551,863 Rounds

11,160 Tons

HE Cartridges:

510,701 Rounds

5,116 Tons

Bombs:

12,068 Bombs

4,756 Tons

Bulk Propellant:

3,977,682 Units

2,607 Tons

The General Dynamics IDIQ Demil Team

GD-OTS
Prime Contractor

- Program Management
- Single Point of Contact
- Safety, Environmental & Quality Programs
- Continuous Improvement & Risk Mitigation
- Cost and Schedule Controls
- Contracts/Subcontracts Management

Demil Operations

Fuzes	Explosive D	ICM	Prop Charges
ICI EBV EEC	EBV ISL	EBV EBV EEC	TPL

Small Cal	Pyrotechnics	HE Cartridges	Bulk Prop	Bombs
GD-OTS ICI EBV EEC	TPL	EBV ISL EBV EEC	TPL	GD-ATP EBV ISL

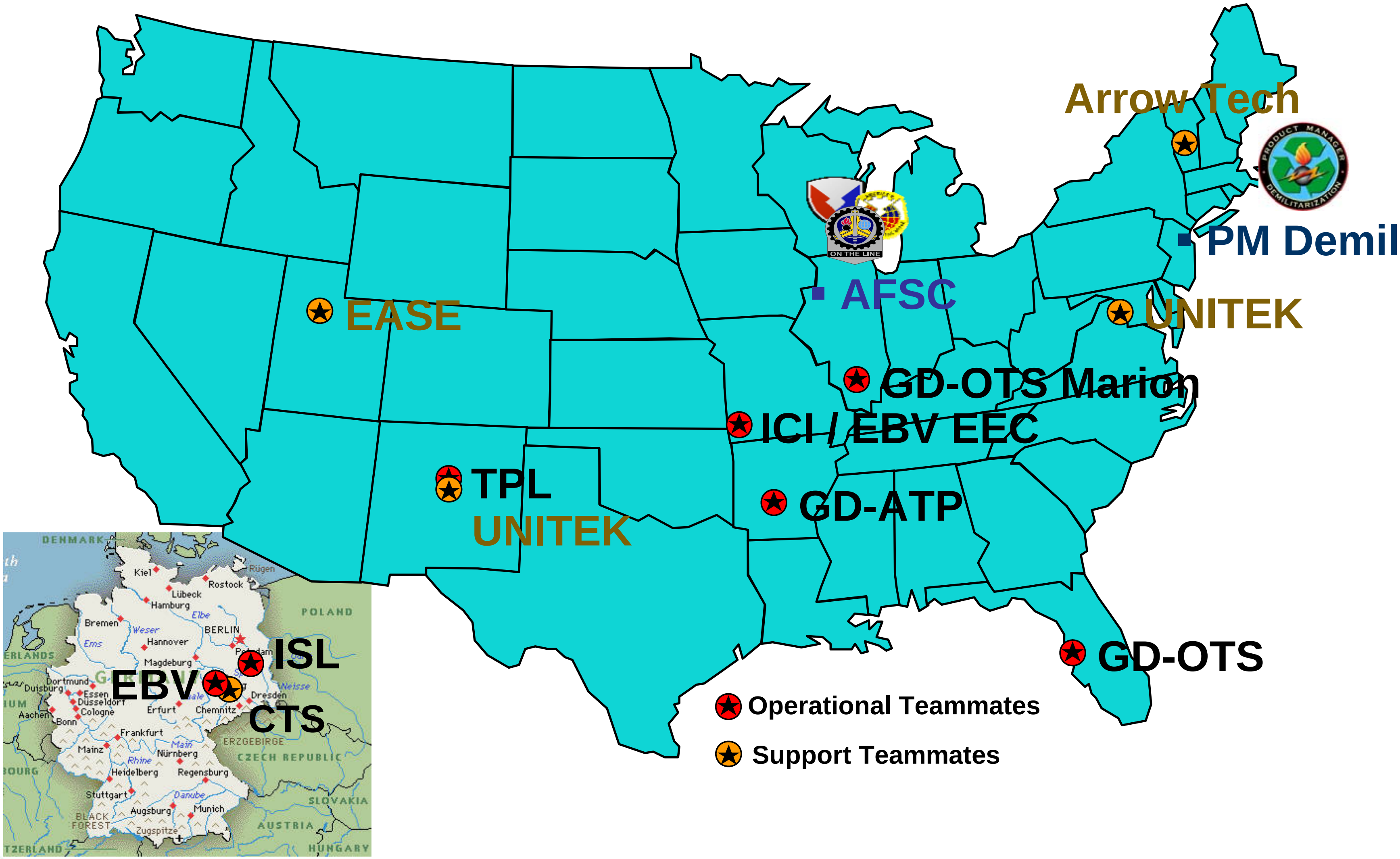
EASE
EHS
- Support Operations
- Consulting
- Permitting
- Safety

UNITEK
Source Surveillance
- Support Operations
- Source Inspection
- COD

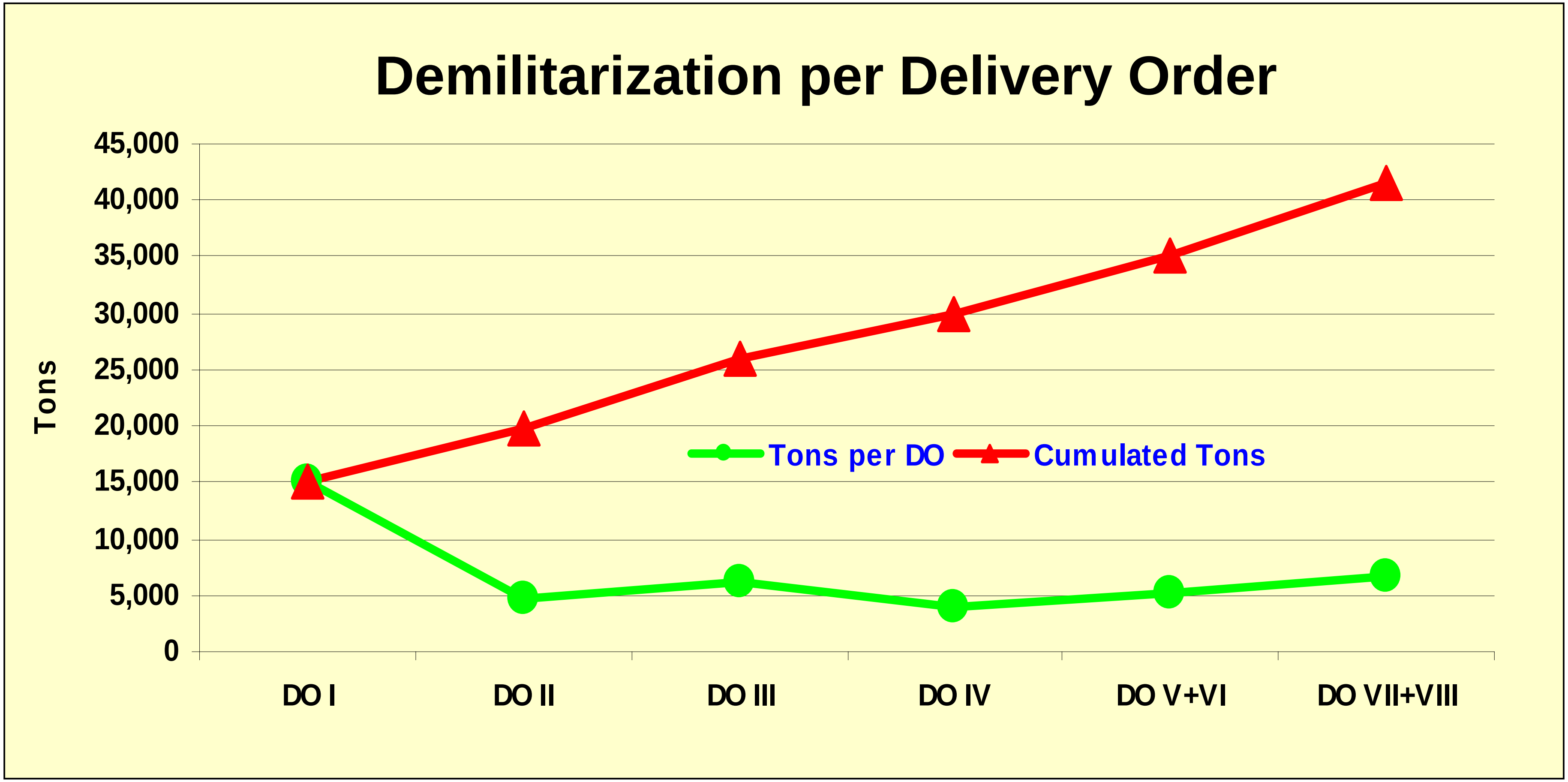
ArrowTech
Demil Database
- Support Operations
- Database Maintenance
- Database Modifications

CTS
Source Surveillance
- Support Operations
- Source Inspection
- COD

IDIQ Demil Team Member Locations



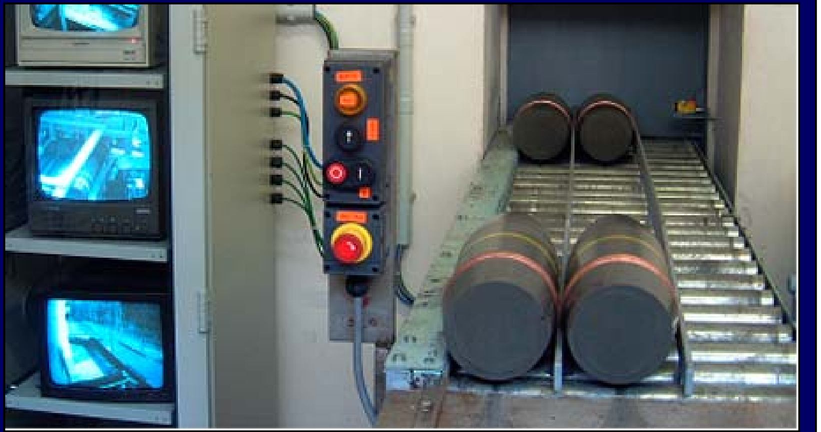
IDIQ Tonnage per Delivery Orders



Explosive D

59,590 Rounds - 5,732 Tons

Explosive D 5” Rounds



Moving rounds to cutting

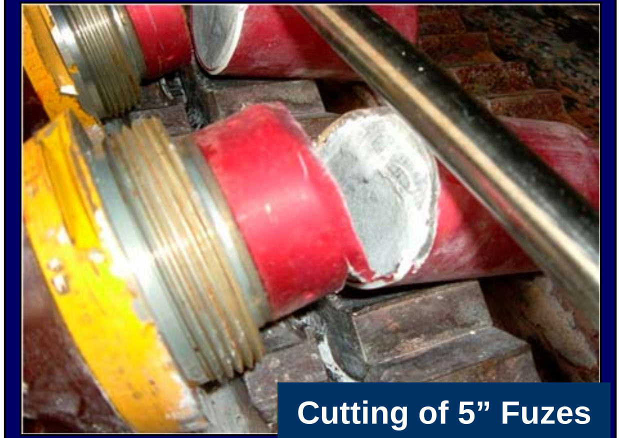
Nick-cutting of rounds

Cut round

Explosive D


Pollution Abatement System


Base with Fuzes


Cutting of 5” Fuzes


Removal of Copper Ring

HE Cartridges Demilitarization

510,701 Rounds - 5,116 Tons

Cutting

Transportation

Steam Heating

TNT Recovery

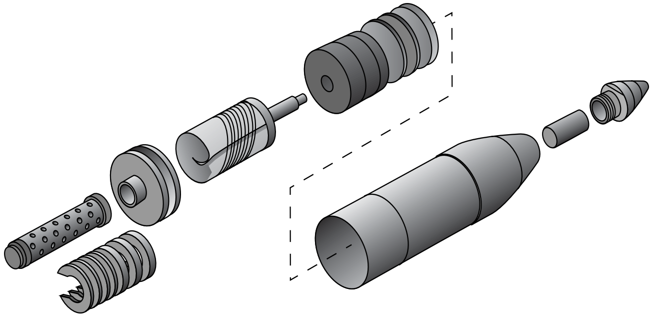
Metal Recovery

Co Recovery

Pyrotechnics Demilitarization

437,445 Rounds - 2,478 Tons

4.2 inch Illuminating Rounds



Disassembly of Rounds

Mg Candles for Resource Recovery

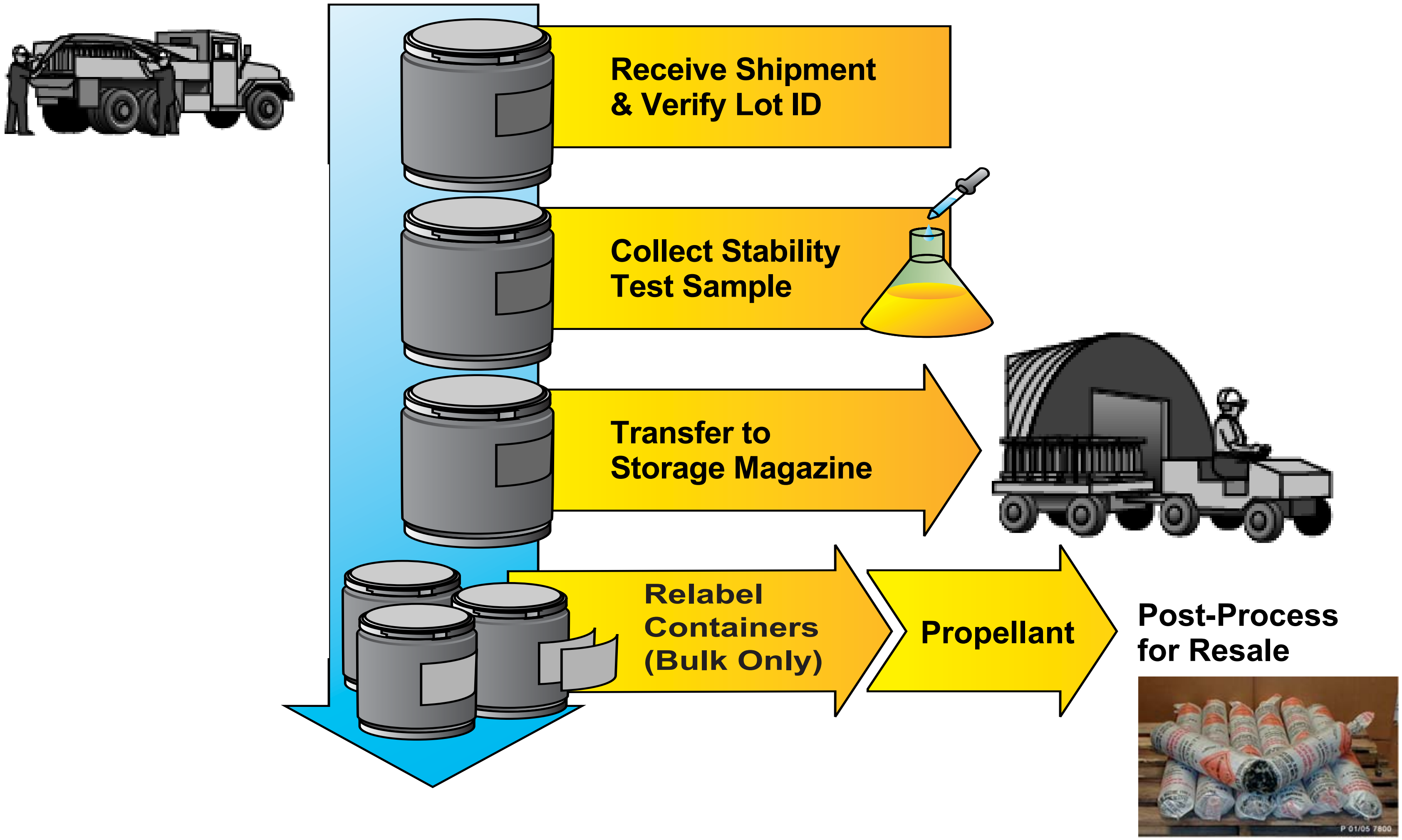
Cutting of the Shells

Metal Recycling

DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

Bulk Propellant Demilitarization

3,977,682 Units - 2,607 Tons



Bombs Demilitarization

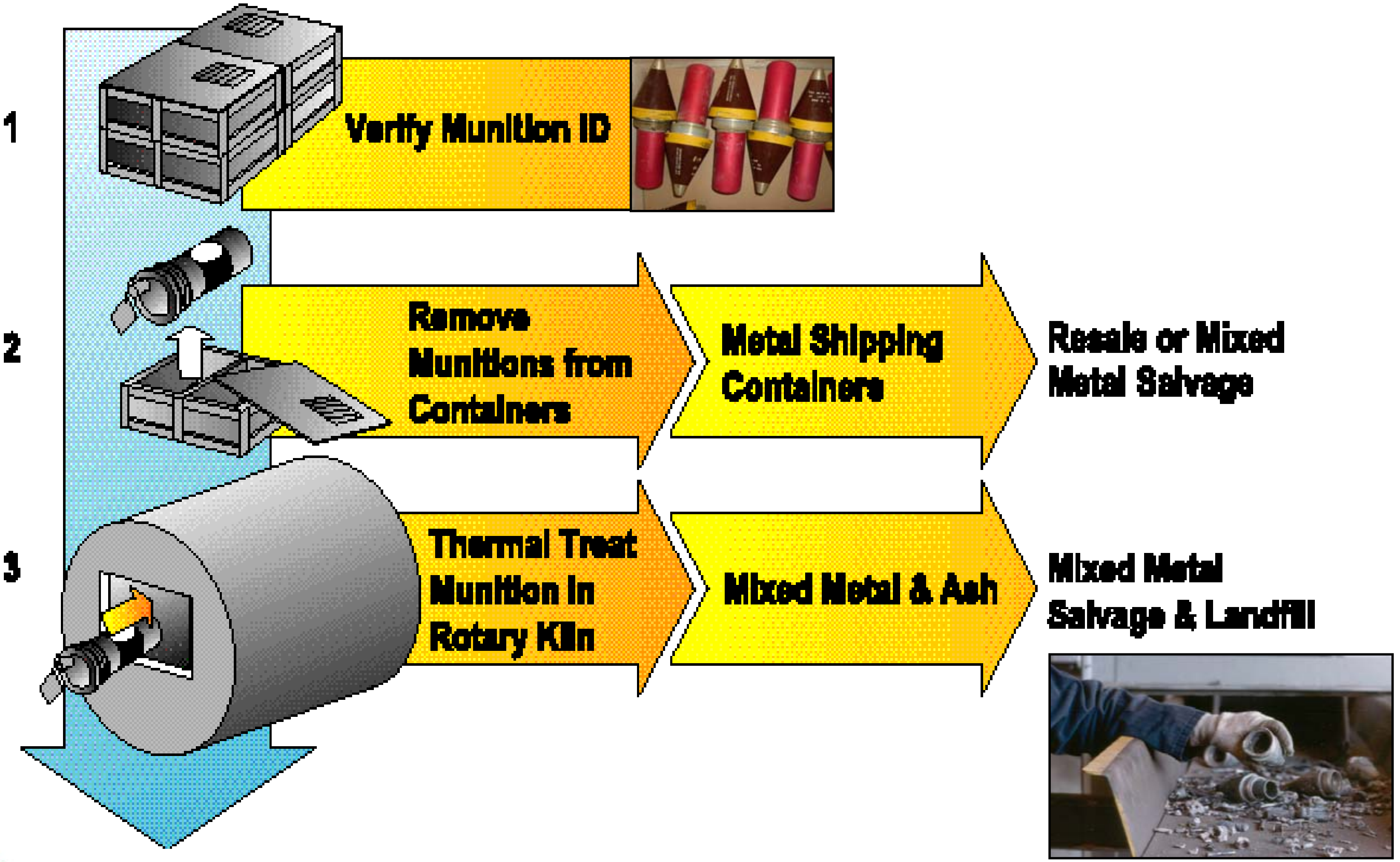
12,068 Units - 4,756 Tons

Press-out and Melt-out

Break-out and Breaking

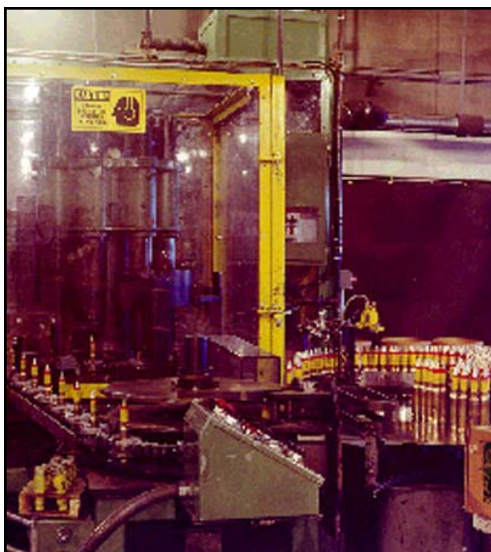
Fuzes Demilitarization

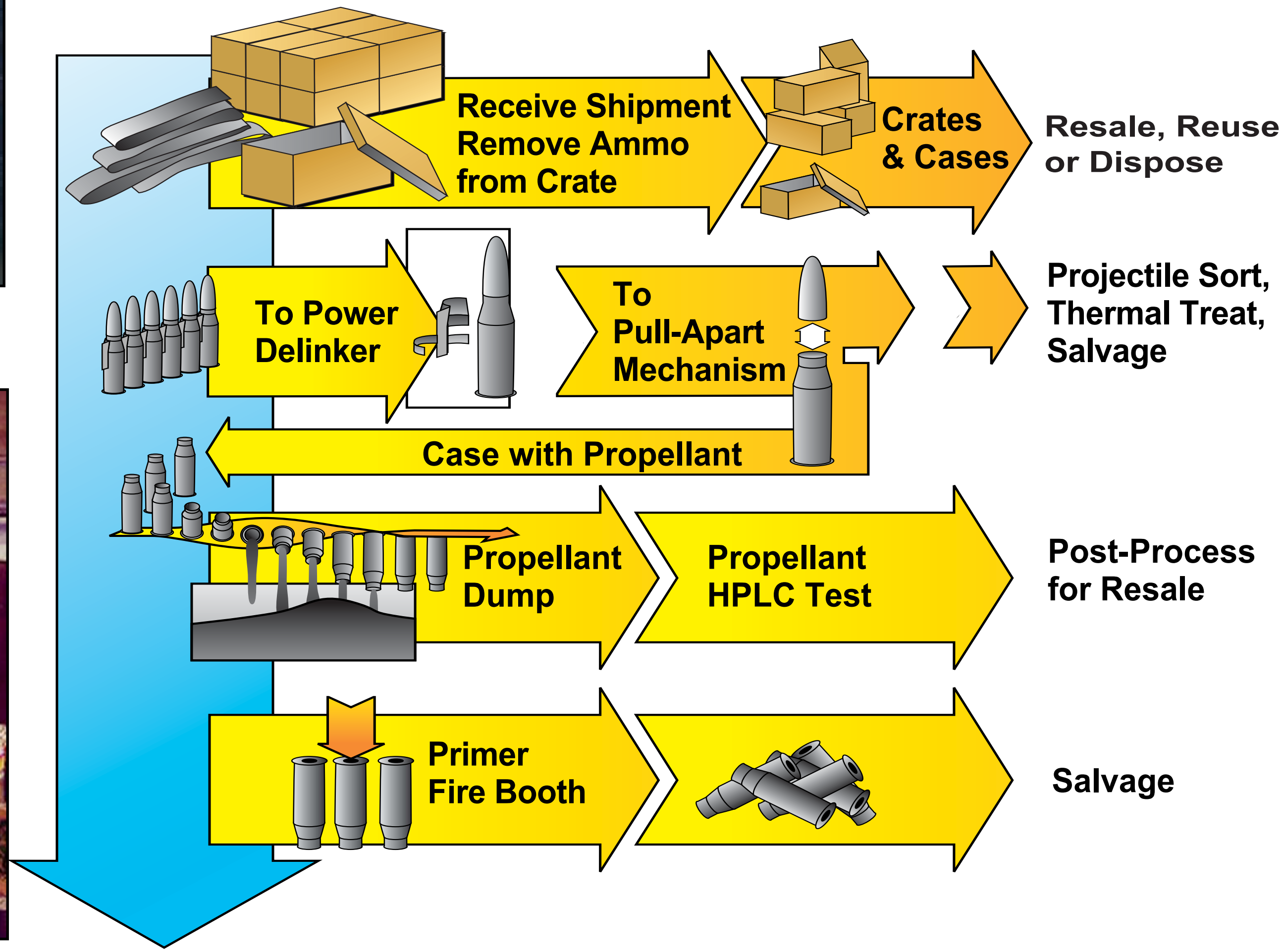
1,361,933 Units - 3,358 Tons



Small Caliber Demilitarization

6,423,430 Rounds - 3,409 Tons





Propelling Charges Demilitarization

551,863 Rounds - 11,160 Tons

Moving Propellant Charges to Production

Loading Conveyor

Removing Propellant

Removing Igniter Bags

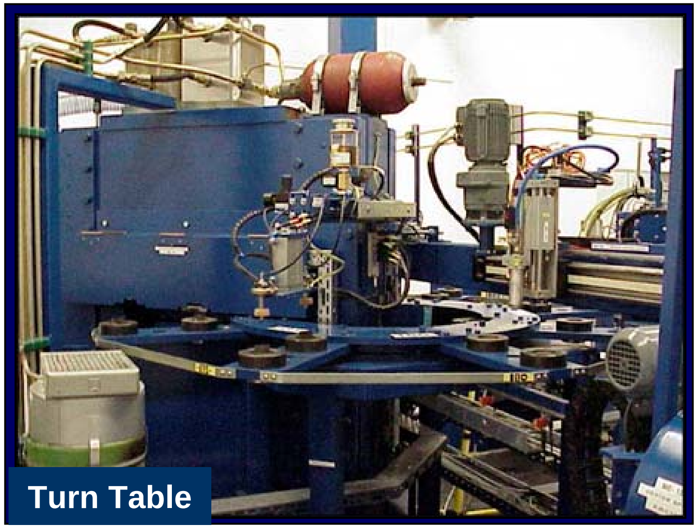
Storing Propellant

DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

ICM Demilitarization

98,001 Rounds - 5,353 Tons


Ogive removal


Turn Table


Fuze Gluing Station


M483 rounds


M42/46 Grenades


Control Room

ICM Demilitarization


Pollution Abatement System


Copper Cone Recycling

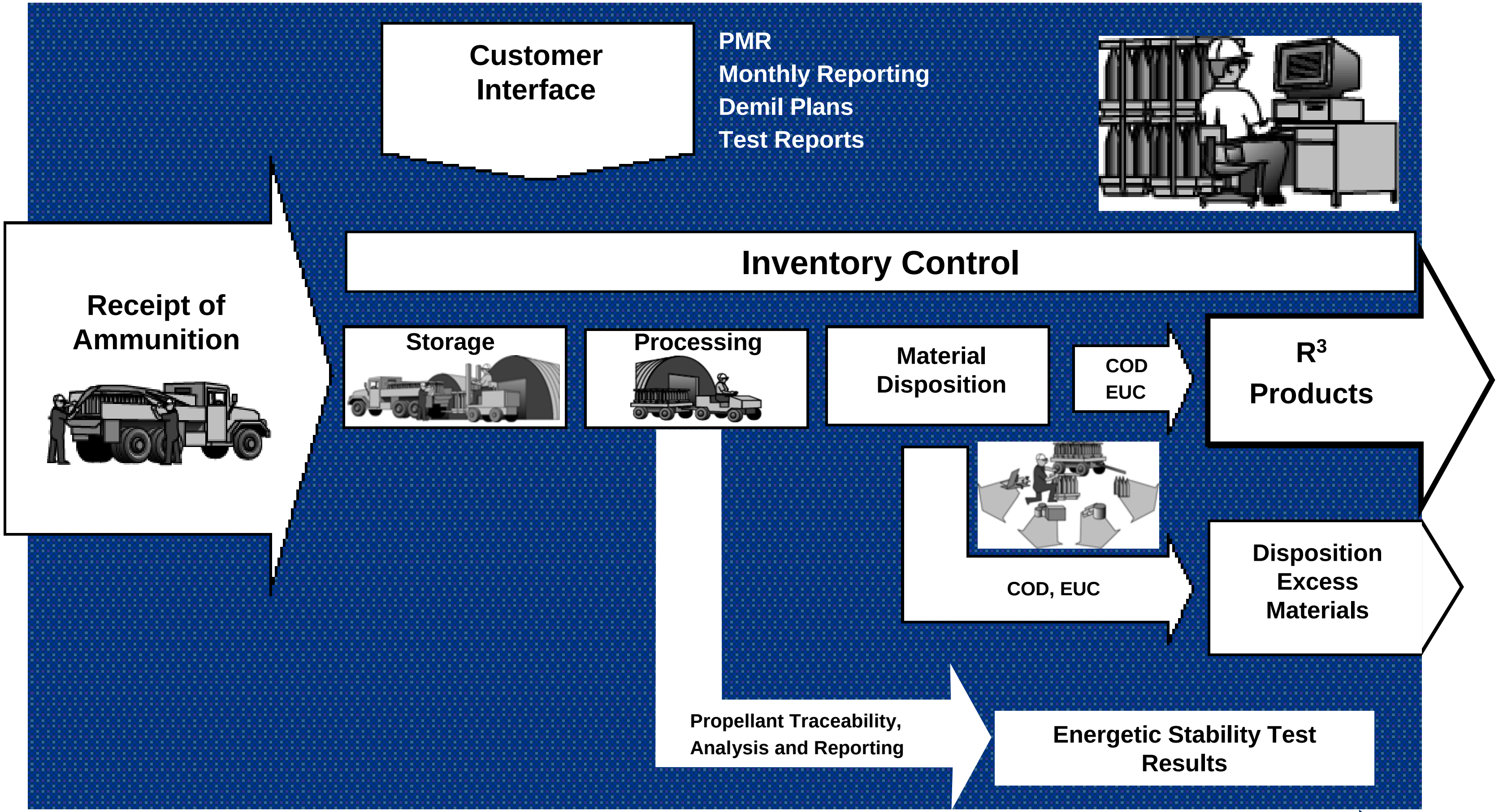

Rotary Kiln


Steel Grenade Body Recycling

R^3 Accomplishments

- R^3 Rate approximately 96% by Weight
- Commercial Resale of Energetic Material for Mining Applications
- 100% of Propellant recycled into Blasting Agent for Mining
- Almost all Metal and Plastics were recycled

Tracking of all Demil Activities via Internet Database



The Demil Database provides visibility for all Demil activities and gives the customer direct oversight into the progress

IDIQ Summary

- Successful execution of IDIQ contract
- We have received tracked, stored and processed more than 13.4 Million ammunition items without a single loss or theft
- Excellent Safety and Environmental records
  - No reportable accidents/incidents for the last six years
  - Total compliance to environmental standards
- Incorporating 6-σ Improvements into Demil Operations
- Establish Internet Based Interactive Demil Database
  - real-time performance tracking for Demil Team and Customer
- Ensured Compliance to all Requirements

GD-OTS Demil Excellence Through Experience

DEMILITARIZATION

Follow-on Demil Contract 2005

Wilfried Meyer
Demil Program Manager
727-578-8304
wmeyer@stp.gd-ots.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

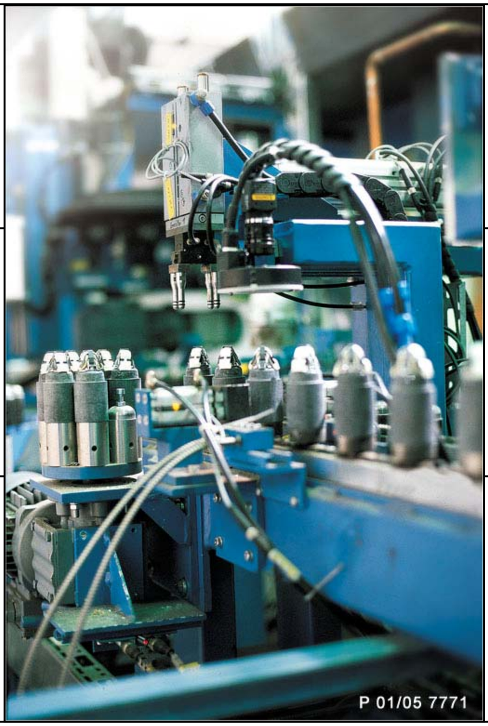
DEMIL 2005
GENERAL DYNAMICS

GD-OTS Demil 2005

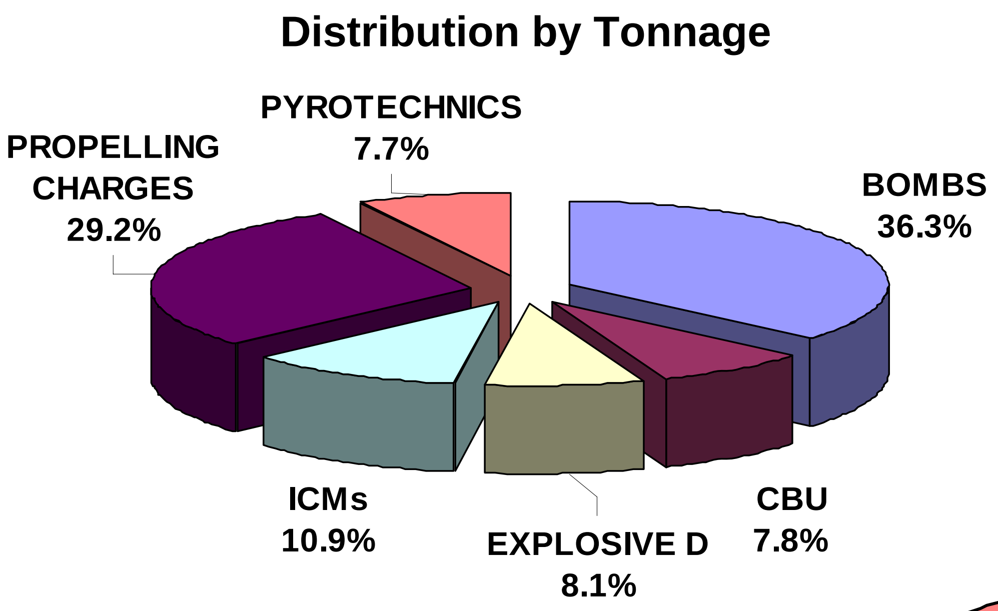
- GD-OTS was awarded on Aug 18, 2005 Follow-on Demil Contract
- Contract award is for Base Year FY 05 with four Option Years through FY 09
- Demilitarization of six Families of Conventional Ammunition Bombs, CBU’s, Propelling Charges, ICM, Explosive D and Pyrotechnics
- We will use only Safe, Environmentally Friendly and Effective Technologies for Resource Recovery and Recycling (R^3)
- GD-OTS selected a team which is committed to ensuring a successful demil program

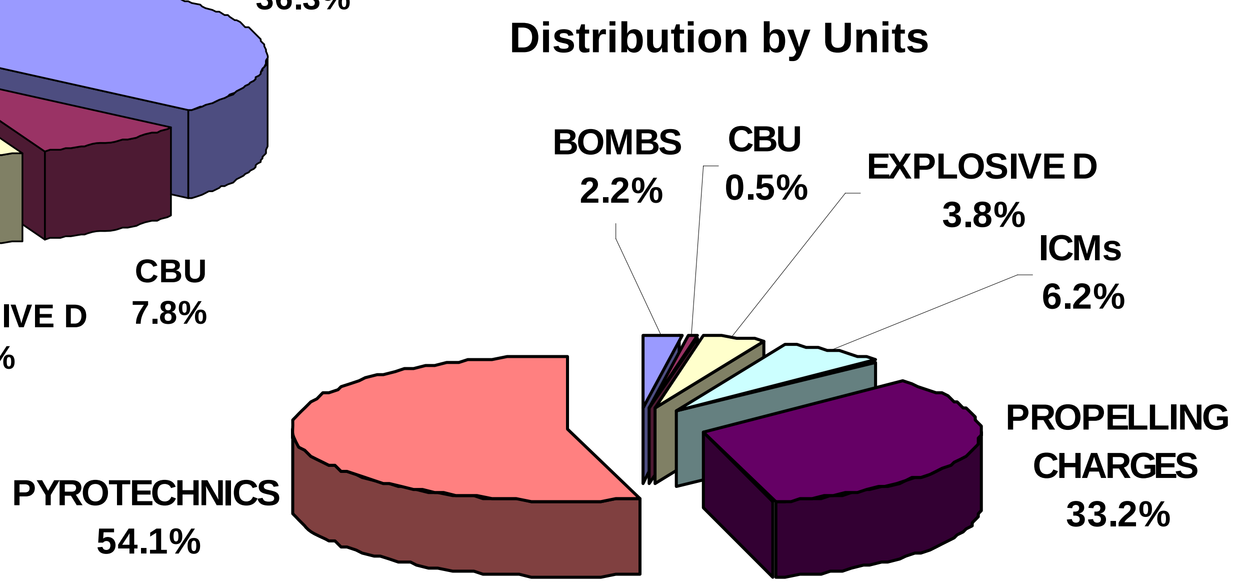
Demil 2005 Base Year Award Aug 18, 05

20,231 Tons / 647,435 Units

CBU: 3,114 Units 1,585 Tons		**Bombs:** 14,225 Rounds 7,350 Tons
Explosive D: 24,810 Rounds 1,630 Tons		**Pyrotechnics:** 350,098 Rounds 1,566 Tons
ICM's: 40,440 Rounds 2,202 Tons		**Propelling Charges:** 214,748 Rounds 5,898 Tons

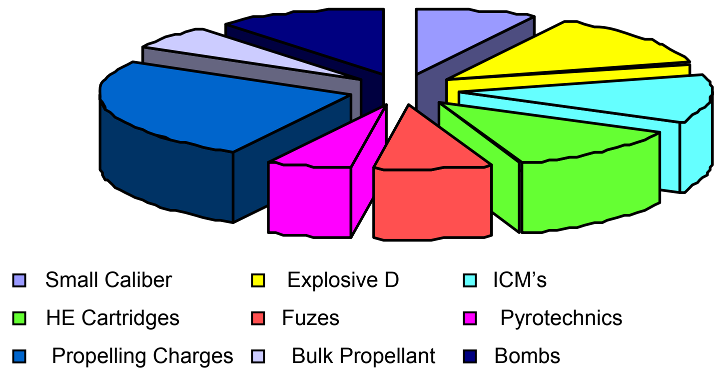
Base Year Award Aug 18, 05
Demil Family Distribution



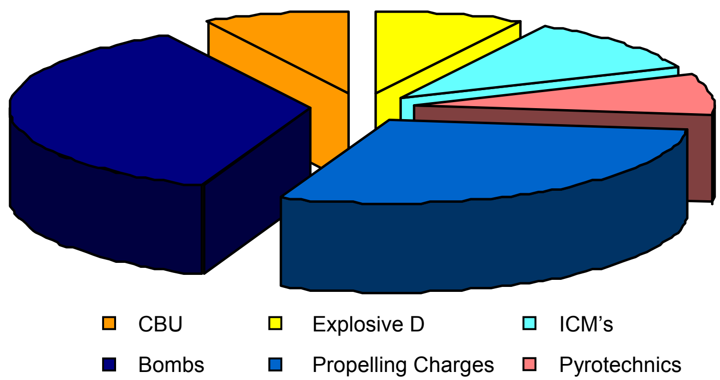


Comparison Demil 2000 versus Demil 2005

Demil 2000
9 Ammunition Families
54 different Types of Ammunition



Demil 2005
6 Ammunition Families
44 different Types of Ammunition



Seven of the Ammunition Types from Demil 2000 are included in Demil 2005

B627 CARTRIDGE 60MM: M83 SERIES ILLUM

C226 CARTRIDGE 81MM ILLUM M301 SERIES

C706 CARTRIDGE 4.2 IN: MORTAR ILLUMINA

D533 CHARGE PROPELLING 155MM: M119

D541 CHARGE PROPELLING 155MM: M4 SER W

D563 PROJECTILE 155MM: HE M483

F114 BOMB, GENERAL PURPOSE, M117, 750 LB

GD-OTS Demil Team

GD-OTS
Prime Contractor

- Program Management
- Single Point of Contact
- Safety, Environmental & Quality Programs
- Continuous Improvement & Risk Mitigation
- Cost and Schedule Controls
- Contracts/Subcontracts Management

EBV EEC
ICM, CBU
Pyrotechnics

EBV EEC
EXPLOSIVES ENVIRONMENTAL COMPANY

McAlester
HE
Bomb

PB/Nammo
Propelling Charges

PB/Nammo
Explosive D

EASE
EHS

EASE, Inc.
Professional Engineering Services

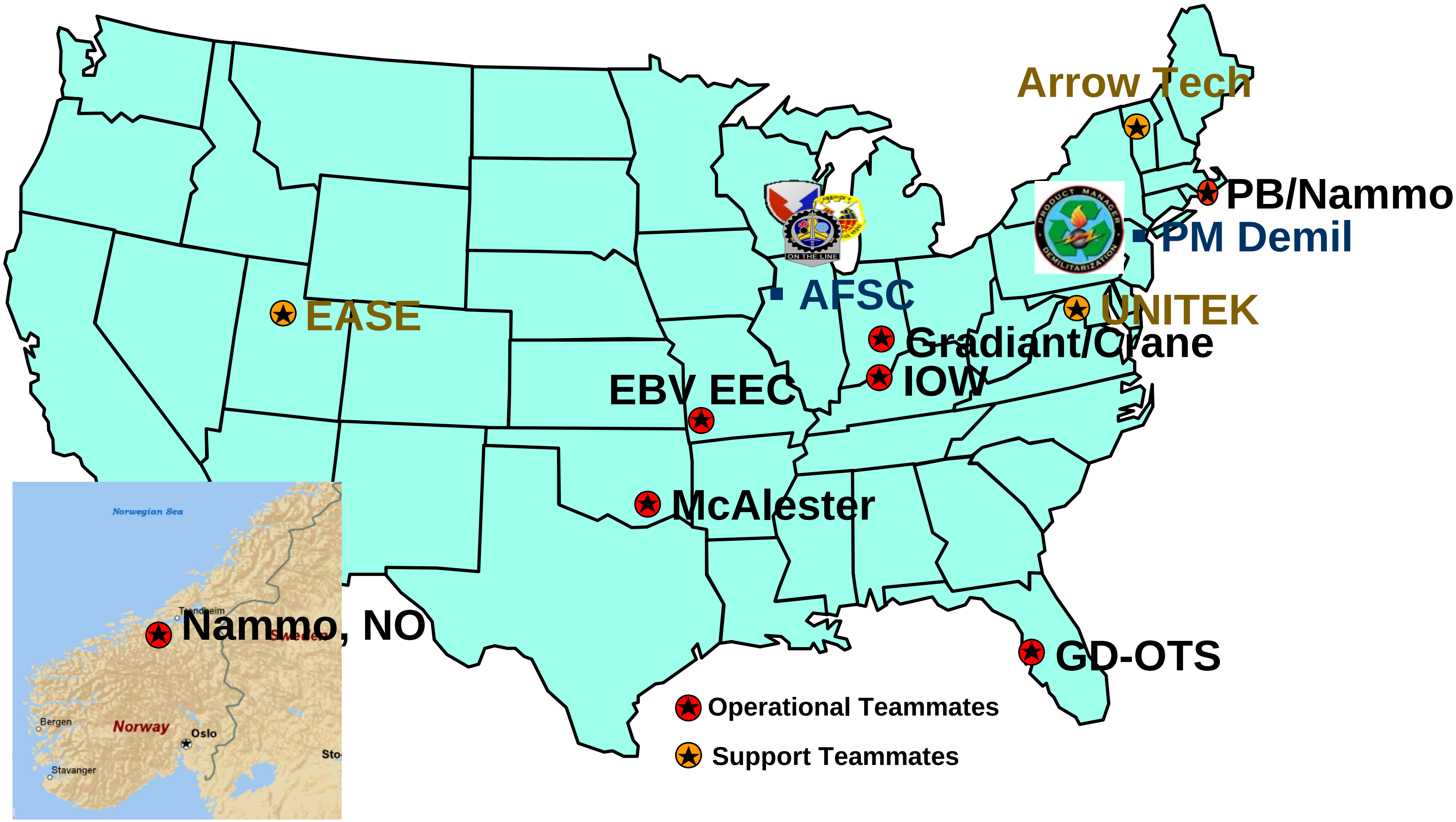
UNITEK
Source Surveillance

UNITEK
U.S. LABS

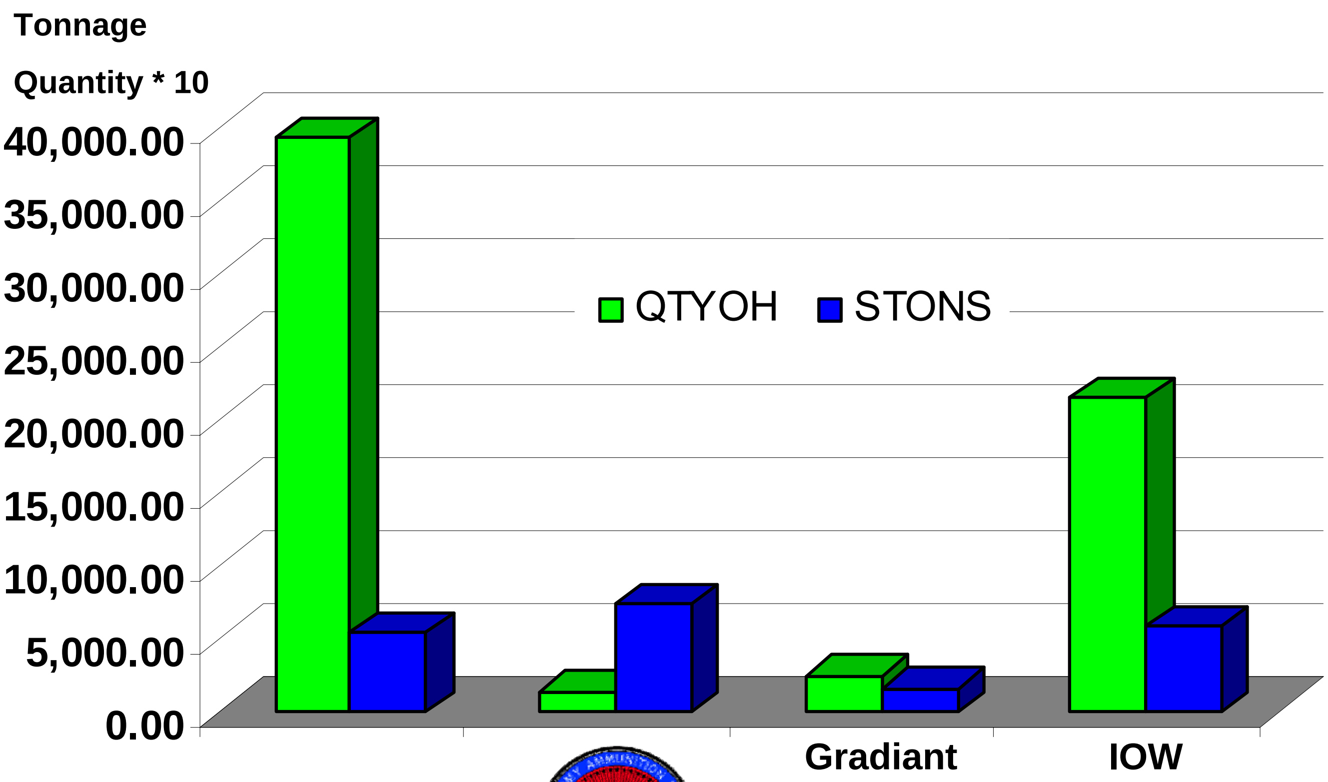
ArrowTech
Demil Database

ARROW TECH

GD-OTS Demil Team Member Locations



Work share Distribution by Tonnage and Quantity



EBV/EEC
EXPLOSIVES ENVIRONMENTAL COMPANY

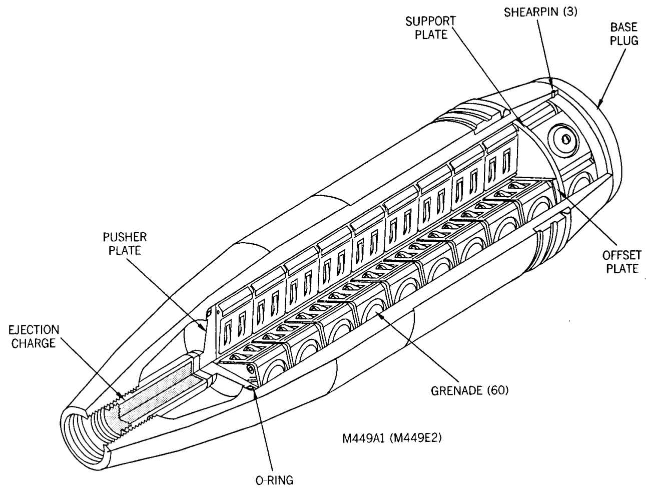
PB/NAMMO

Demil Families Awarded

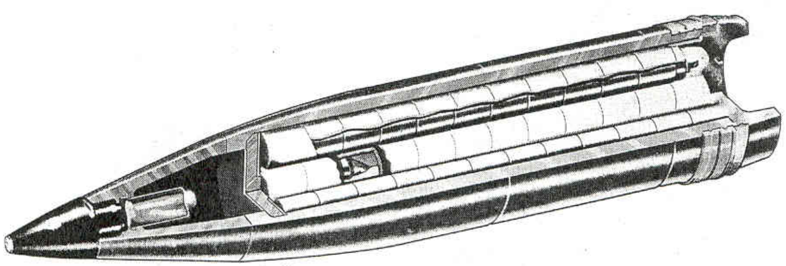
ICM Base Year Award Aug 18, 05

2,202 Tons / 40,440 Units

DODIC	Nomen	Quantity	Tonnage [t]	Grenades
D562	M449	1,574	78	M43
D563	M483	38,866	2,123	M42/46



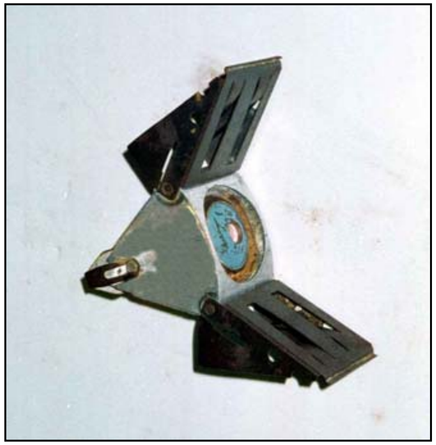
ICM M449 Projectile 155 mm (D562)

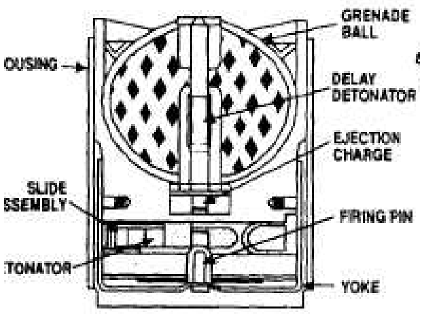


ICM M 483 Projectile 155 mm (D563)

ICM Grenades

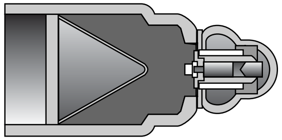
Grenade M43





CROSS SECTION

Grenades	Units/ICM	HE	HE/Grenade
M43	60	Comp A5	2.9 lbs
M42/46	64/24	Comp A5	5.8 lbs



Grenade M42/46

Explosive D Base Year Award Aug 18, 05

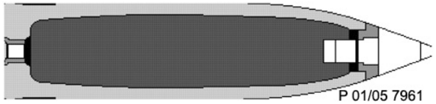
1,630 Tons / 24,810 Units

DODIC	Projectile	Quantity	Tonnage [t]	NEW/Unit [lbs]
D235	5”	2,582	81.5	7.7
D330	5”	2,514	95.1	7.9
D394	6”	10,056	693	2
D400/401/406	6”	22,294	1,281	14
D631	8”	2,516	348.6	21.3

5” HE Shell

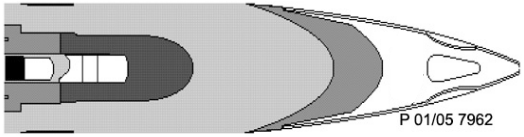
D235 and D330

6”/47 Cal Shell



D400, D401, D406

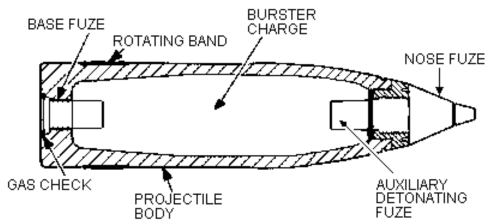
6” & 8”/55 Cal HDPC Shell



D394 & D631

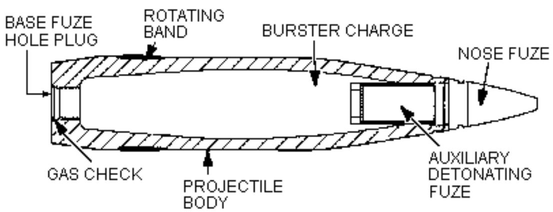
Explosive D Rounds

PROJECTILE 5 IN/ 38 CAL HC :
MK35, MK49 or MK52



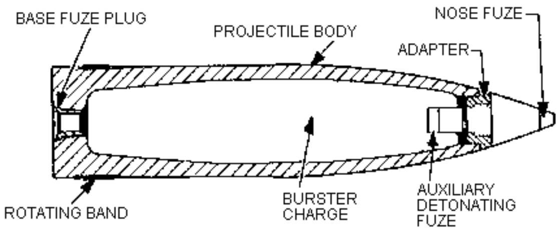
D235

PROJECTILE 5 IN/ 54 CAL HE-PD:
MK41, MK55, MK61, MK64 or MK80



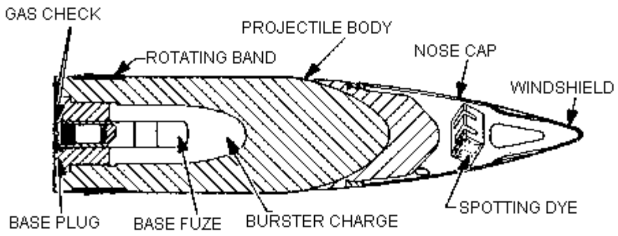
D330

PROJECTILE, 6 IN/47 CAL, HC:
MK34 or MK40



D400, D401, D406

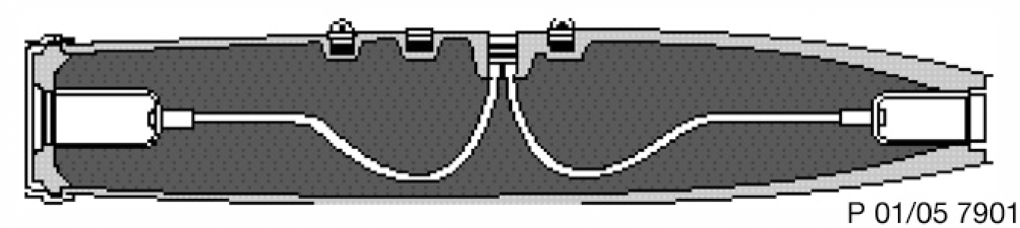
PROJECTILE, 6 IN/47 CAL, AP, MK35



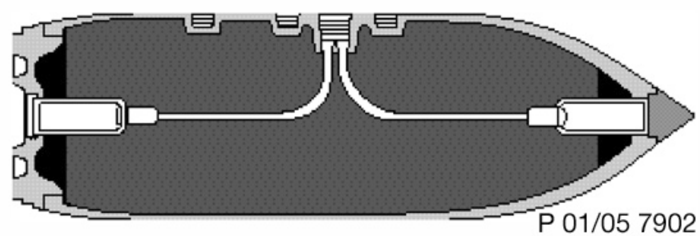
D394

Bombs Base Year Award Aug 18, 05

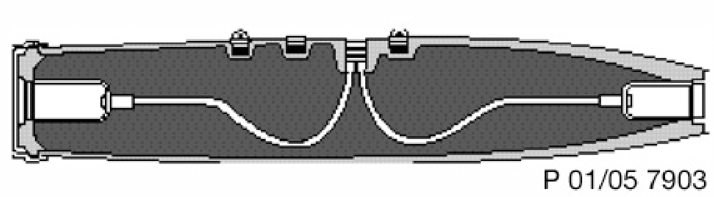
7,307 Tons / 14,225 Units



F127, F272 MK 84 2000 lbs Bomb



F114 M117 750 lbs Bomb



E480 MK82 500 lbs Bomb

Bombs Base Year Award

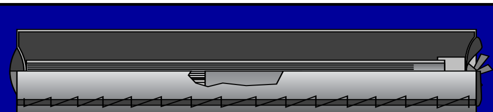
7,307 Tons / 14,225 Units

DODIC	Nomen	Quantity	Tonnage [t]	Weight/Bomb [lbs]	NEW/Bomb [lbs]	HE
E480	MK82	1,019	262	500	192	Tritonal
F114	M117	10,521	4,277	750	368	Tritonal
F127	MK84	1,703	1,755	2000	945	Comp H6
F272	MK84	982	1,012	2000	945	Comp H6

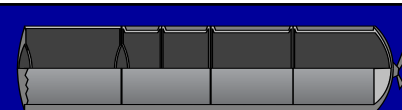
Propelling Charges Base Year Award Aug 18, 05

5,868 Tons / 214,748 Units

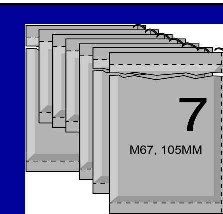
DODIC	Nomenclature	Quantity	Total Weight [t]	PEP/Unit [lbs]
C436	105 mm	18,259	30.7	2.8
D532	155 mm	1,263	32.6	27.6
D533	155 mm	44,841	966.6	23.5
D534	155 mm	425	6.6	18.1
D540	155 mm	12,449	90.6	6.1
D541	155 mm	24,021	363.6	13.3



Propelling Charge
155mm, M119/A/A2
D533, D534, D540



Propelling Charge
155mm, M4A1/A2
D541

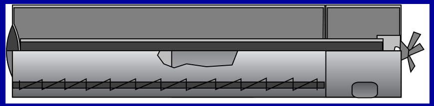


105mm, M67 C436

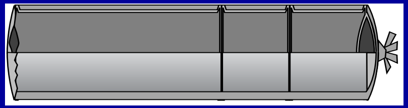
Propelling Charges Base Year Award Aug 18, 05

5,868 Tons / 214,748 Units

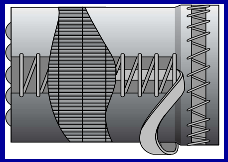
DODIC	Nomenclature	Quantity	Total Weight [t]	PEP/Unit [lbs]
D661	8 inch	953	36.7	39.7
D662	8 inch	54,775	2,108.8	45.4
D675	8 inch	8,117	125.8	19.9
D676	8 inch	45,280	1,216	26.8
D839	16 inch	4,365	920.62	664.6



Propelling Charge
8” M188E3 D661, D662



Propelling Charge
8” M2 D676

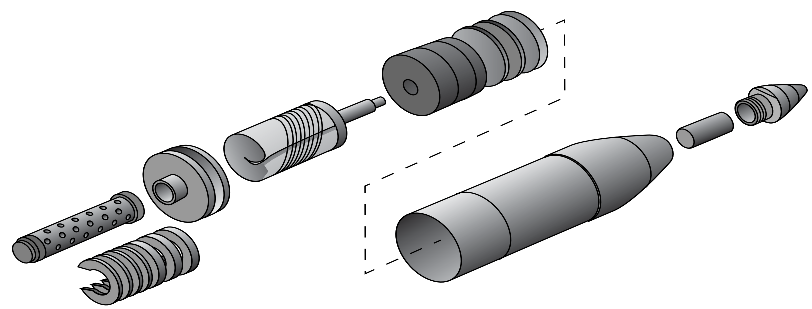


Propelling Charge
16/50 Reduced Flash D839

Pyrotechnics Base Year Award Aug 18, 05

1,566 Tons / 350,098 Units

Unit	Quantity	Total Weight [t]
Flares	81,251	445.7
Mortars/Grenades	191,284	396.4
105 mm/155 mm	19,123	644.9
Photoflash	58,440	79.1

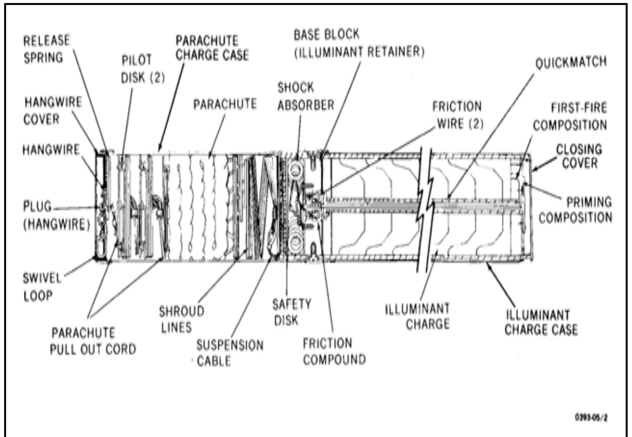


Pyrotechnics Flares

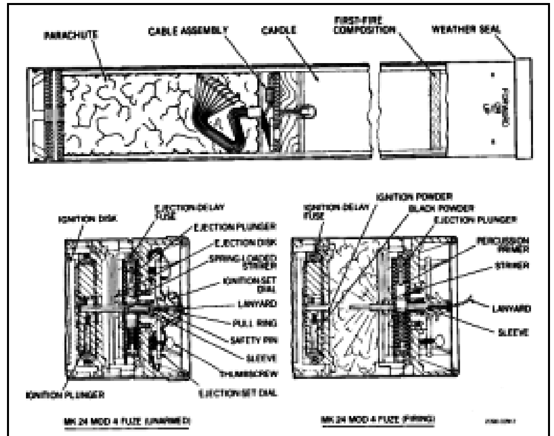
445.7 Tons / 81,251 Units

DODIC	Nomenclature	Quantity	Total Weight [t]	PEP/Unit [lbs]
L388	Aircraft Para	1,936	28.36	10.3
L407	Aircraft Para	118	1.65	16.0
L410	Aircraft Countermeasures	55,441	41.4	0.3
L411	Aircraft Para	7,234	125.6	22.0
L419	Aircraft Para	520	8.8	16.1
L424	Aircraft Para	6,958	102.8	17.6
L426	Aircraft Para	3,834	59.8	17.6
L427	Aircraft Para	5,210	77.37	17.6

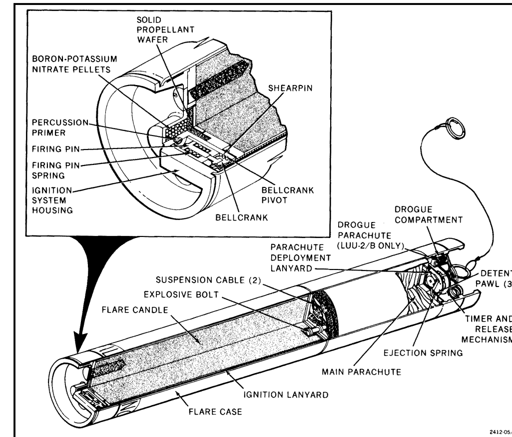
Pyrotechnics Flares



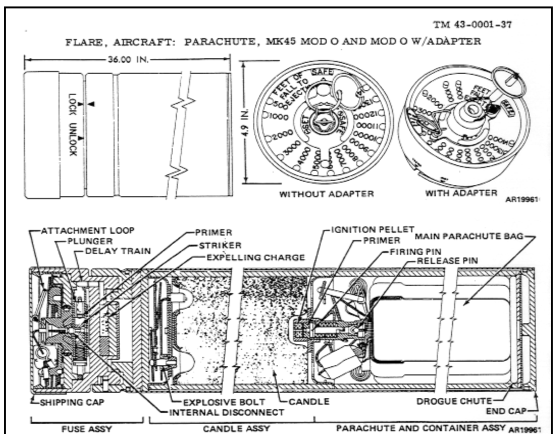
L424/L426/L427 Flare Mk 45



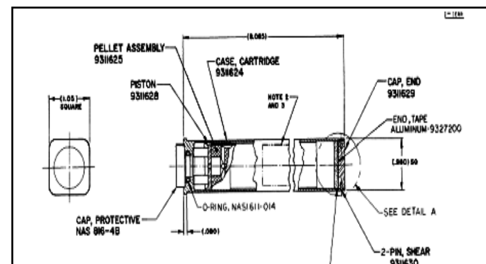
L411 Flare LUU-2A/B



L407/L419 Flare Mk 24



L388 Flare M8



L410 Flare CM M206

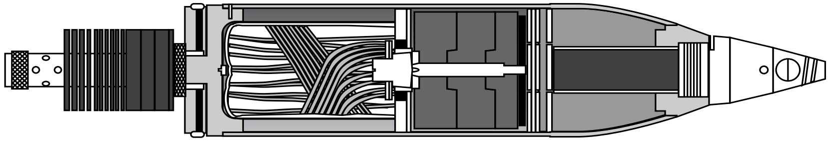
Pyrotechnics Mortars/Grenades

396.4 Tons / 191,284 Units

DODIC	Nomenclature	Quantity	Total Weight [t]	PEP/Unit [lbs]
B627	60 mm Illuminating	55,438	178.8	0.58
C226	81 mm Illuminating	303	2.71	1.75
C706	4.2 inch Illuminating	7,729	160.4	4.29
G895	Grenade, Hand Illuminating	127,814	54.6	0.21

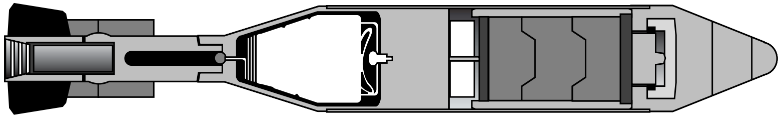
4.2 inch Illuminating

DODIC C706 M335



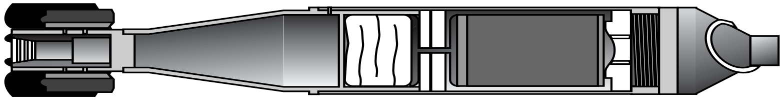
81 mm Illuminating

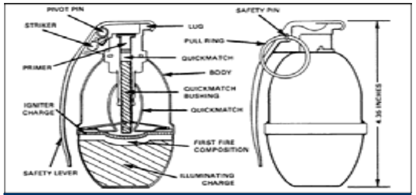
DODIC C226 A301



60 mm Illuminating

DODIC B627 M83





DODIC G895 - Grenade, Hand Illuminating (Typical)

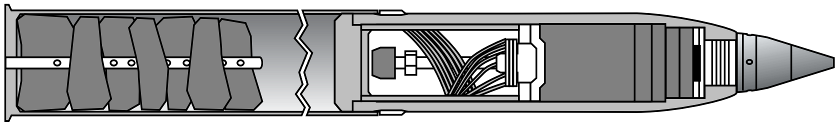
Pyrotechnics Family 105 mm / 155 mm

556.3 Tons / 19,123 Units

DODIC	Nomenclature	Quantity	Total Weight [t]	PEP/Unit [lbs]
C449	Cartridge 105 mm Illumination M314	13,380	401.4	5.1
C542	Cartridge 105 mm Illumination M314	1,969	59	5.1
D505	Projectile 155 mm Illumination M485	3,774	184.5	6.25

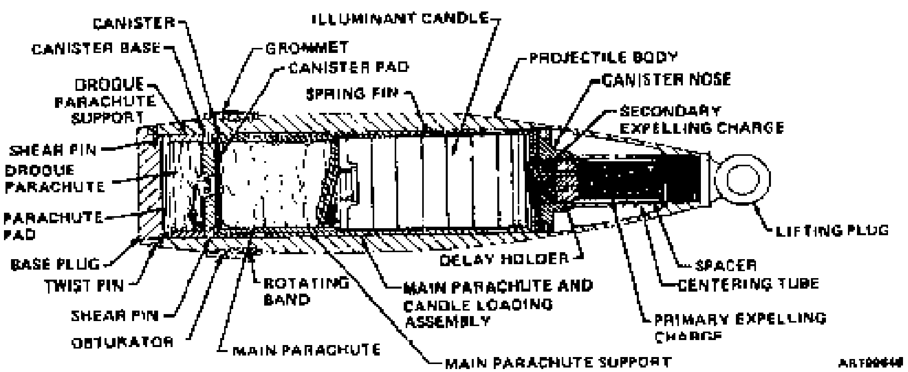
105 mm Illuminating M314A2

DODIC D449, D542



155 mm Illuminating M485

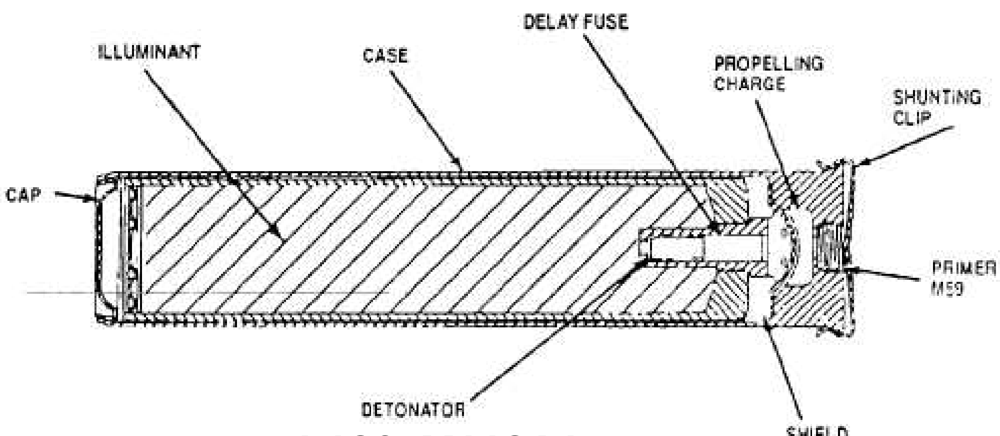
DODIC D505



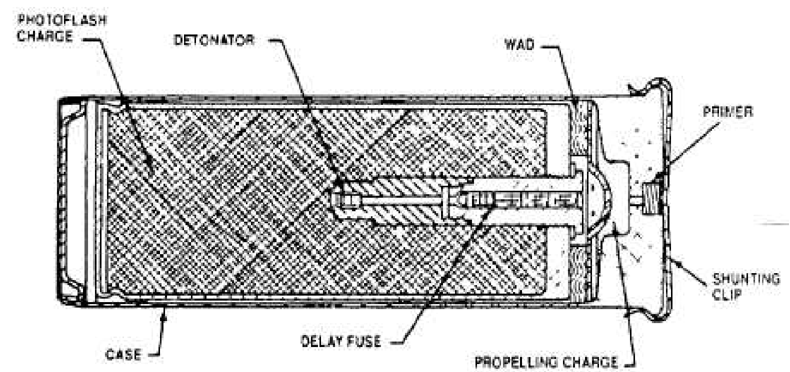
Pyrotechnics Family Photoflash

79.19 Tons / 58,440 Units

DODIC	Nomenclature	Quantity	Total Weight [t]	PEP/Unit [lbs]
L136	Cartridge Photoflash M112A1	47,156	44.21	0.45
L139	Cartridge Photoflash M123A1	11,284	34.98	1.56



L136, M112A1

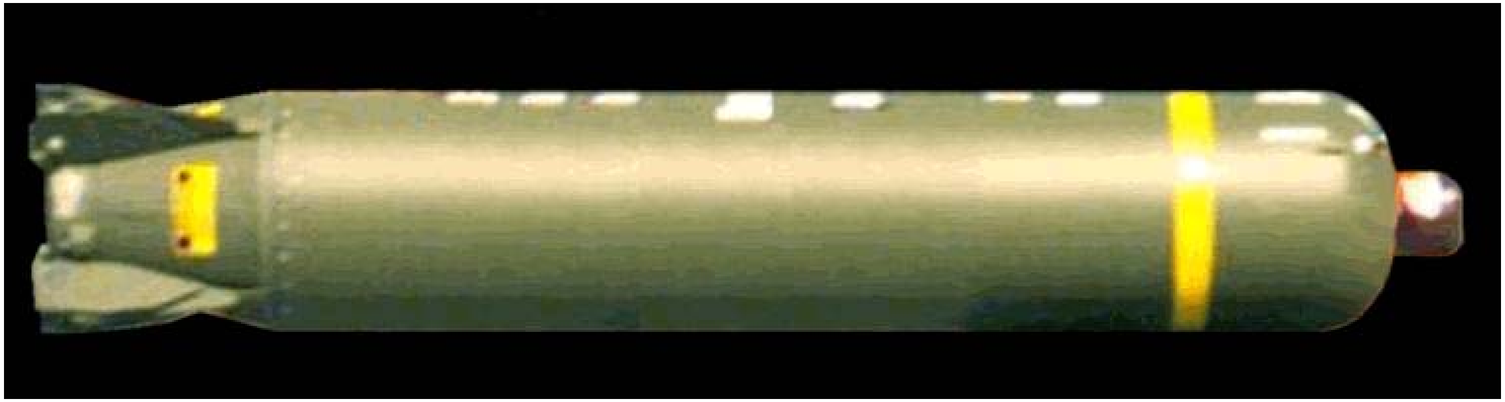


L139 M123A1

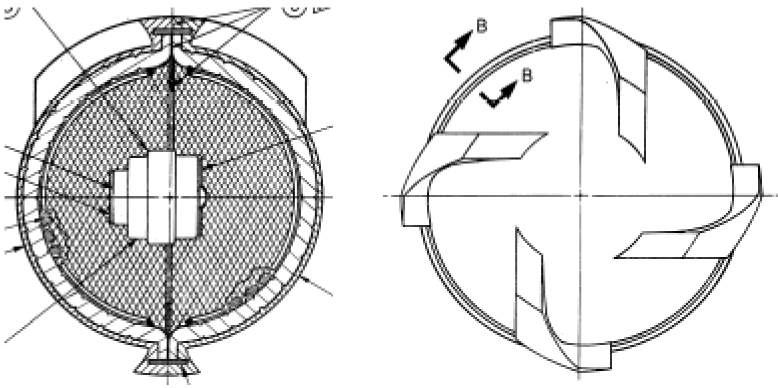
Base Year Award CBU

1,585 Tons / 3,114 Units

DODIC	Nomen	Quantity	Tonnage [t]	Grenades	Quantity /CBU	NEW/ CBU [lbs]	HE
E800	52B/B	790	394	BLU 61 A/B	220	134	Cyclotol
E803	58/B 58A/B	508 851	259 432	BLU 63/B BLU 63A/B	650	190	Cyclotol
E828	71/B	965	498	BLU 86/B	650	167	Comp B

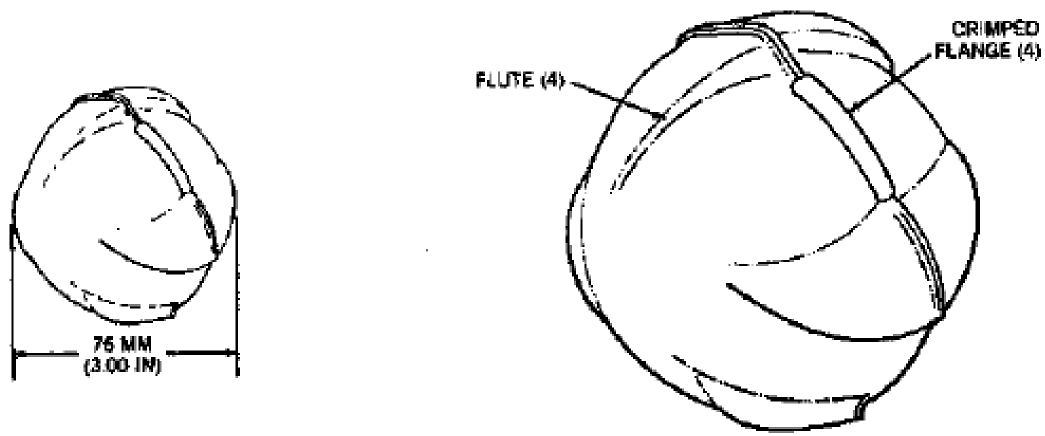


CBU Grenades



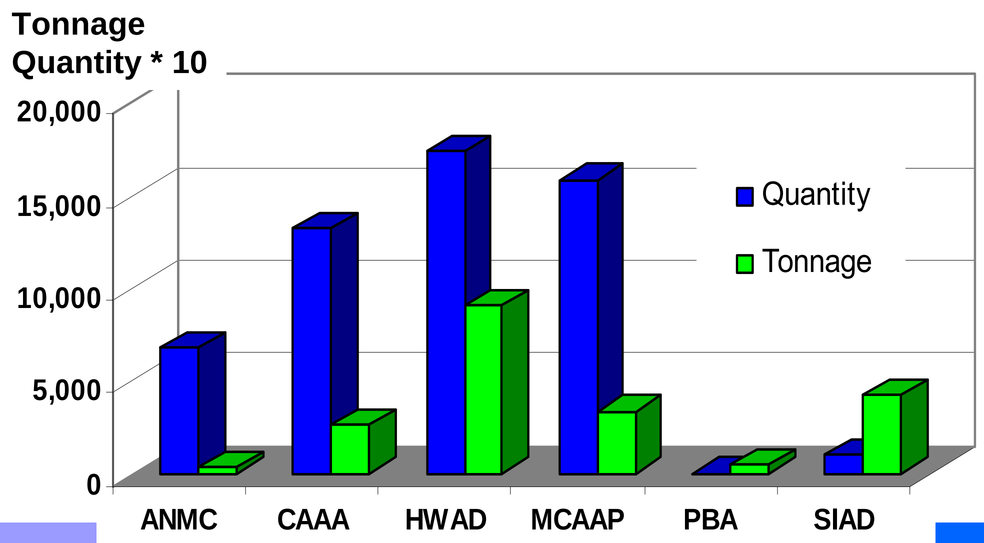
BLU 61 A/B

Grenades	Quantity /CBU	NEW/ Grenade
BLU 61 A/B	220	0.61 lbs
BLU 63/B BLU 63A/B	650	0.26 lbs 0.28 lbs
BLU 86/B	650	0.26 lbs

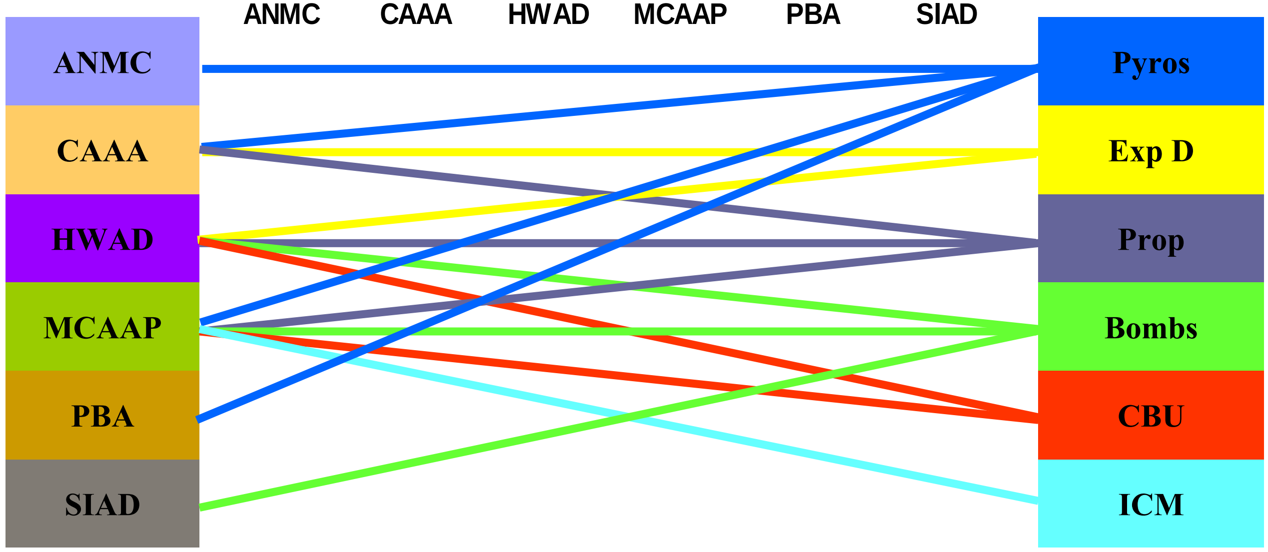


BLU 63/B, 63A/B, BLU 86/B

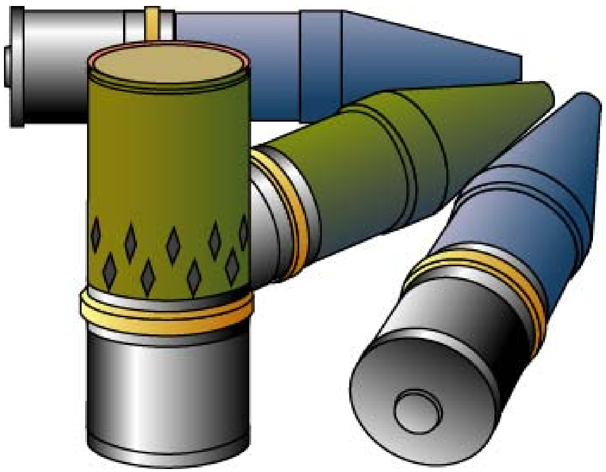
Storage Facilities - Quantity and Tonnage



Anniston Munitions Center
Crane Army Ammunition Activity
Hawthorne Army Depot
McAlester Army Ammunition Plant
Pine Bluff Arsenal
Sierra Army Depot



Status of Contract Execution



- We are ready to execute
- Stop Work Order in Effect
- Awaiting Resolution of Protest

GD-OTS Demil Team

QUESTIONS?

ROK-US Joint
Munitions Demil Facility in Korea

Presented by:
COL Kisoo Lee
Ministry of National Defense
Republic of Korea

Presented at:
2006 Global Demilitarization Symposium & Exhibition
1-5 May 2006

Background

- Under the SALS-K between the ROK and the US, the US has continued to store up to 600,000 tons of conventional ammo.
- Substantial quantity of these aging US-titled munitions is in the demil candidate stockpiles.

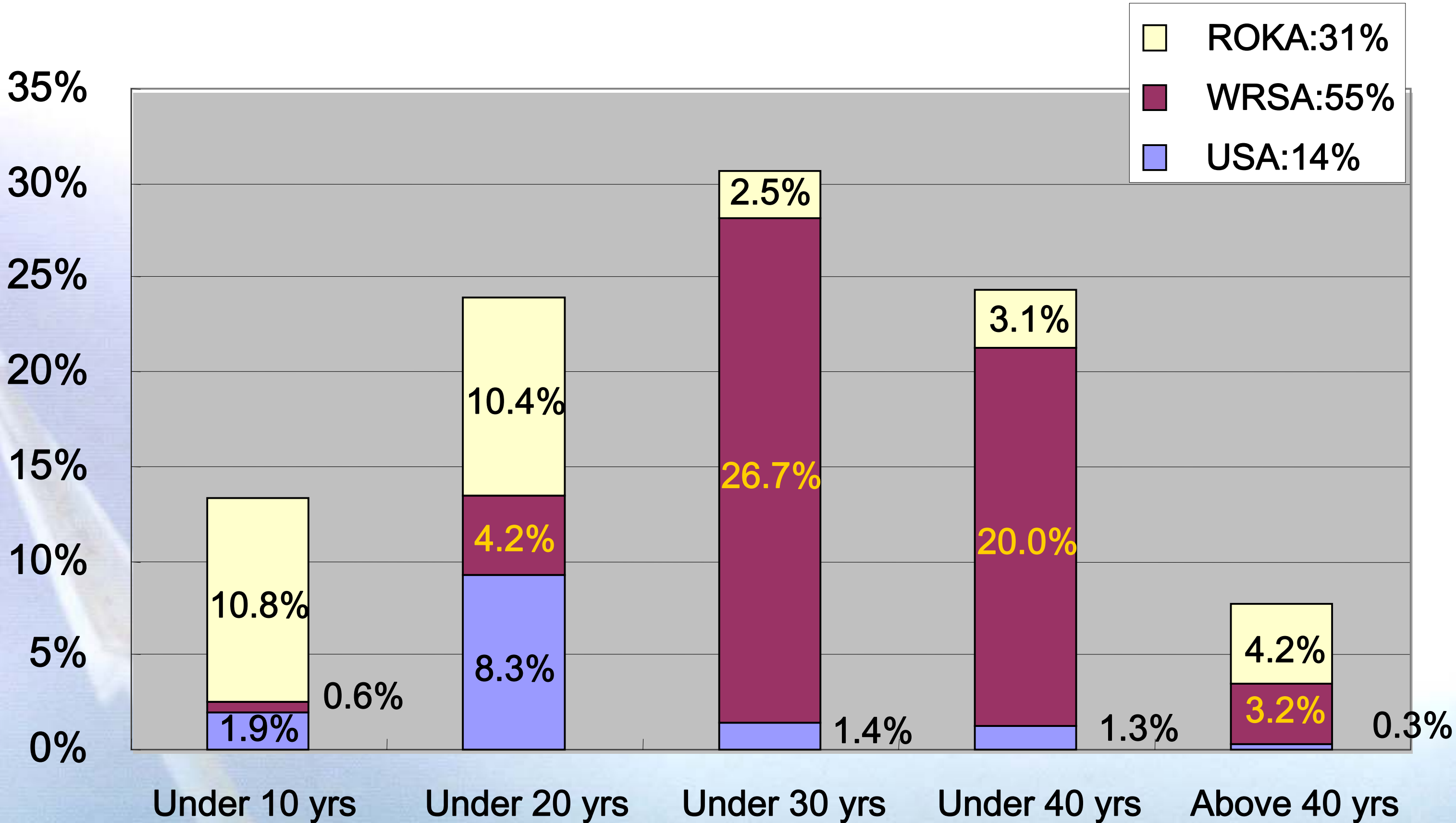
Demil Candiadtes:
PACOM-All Services

Short Tons

	ARMY	NAVY	USMC	AIR FORCE	TOTAL
ALASKA	24	0	0	34	58
HAWAII	64	43	0	1	108
GUAM	0	7	0	19,435	19,442
JAPAN	1,013	214	52	20	1,299
KOREA	94,786	0	0	53	94,839
THAILAND	0	0	0	0	0
TOTAL	95,887	264	52	19,543	115,746

Source: 2000 Global Demil Symposium, "US/ROK Pacific Demil", Mr.Hackett

Age Distribution of the Stockpile



Background (continued)

- Due to current national and international environmental restrictions and safety concerns, OB/OD is no longer acceptable means of large scale demil.

- ROK and US agreed to establish a Joint Munitions Demil Facility (DEFAC) in the ROK employing modern technologies and complying with environmental regulations.


R3
Safety
Prevent
Pollution
The Goal

MOA between ROK and US

- MOA for Construction, Operation and Maintenance of a Joint Munitions DEFAC in Korea was established in 1999.
- The Improved MOA was signed in Sep. 2003
- The ROK and the US will obtain and position equipment.

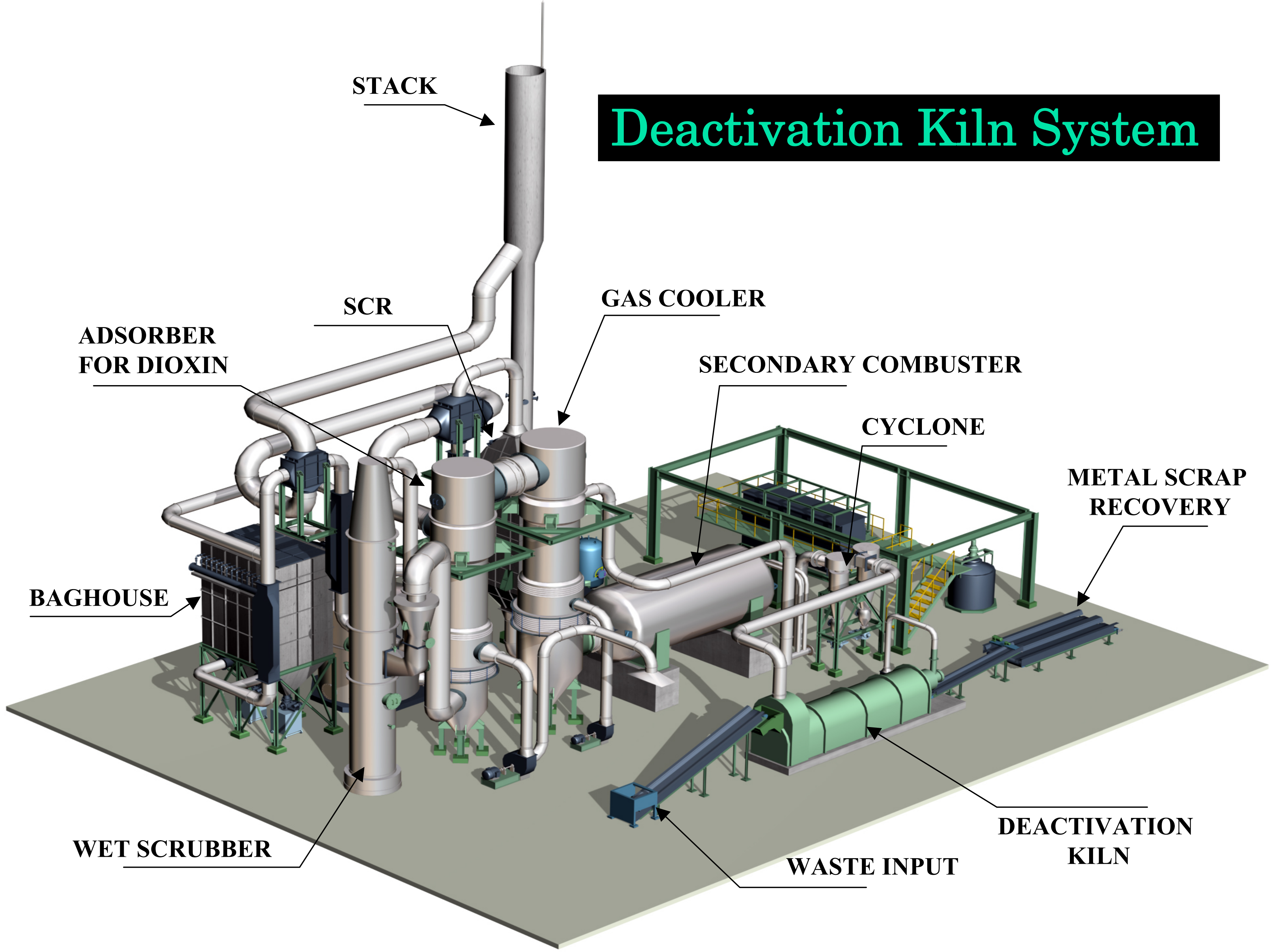
Responsibility of ROK and US

- ROK will
  - Provide Land, Facility, and Utilities
  - Provide Deactivation Kiln System
  - Operate the facility as a GOCO program

- US will
  - Provide APE's and Newly Developed Tech., i.e. PCF, MSO and SCWO
  - Provide Technical Support

Current Status by Apr '06

- Final negotiation stage for MOA Annexes, including the Demil Operational Cost
- Completed detailed design for Construction
- US continues the Validation Test for the newly developed technologies
- ROK started fabrication design for the Deactivation Kiln System


Deactivation Kiln System
STACK
SCR
GAS COOLER
ADSORBER
FOR DIOXIN
SECONDARY COMBUSTER
CYCLONE
METAL SCRAP
RECOVERY
BAGHOUSE
WET SCRUBBER
WASTE INPUT
DEACTIVATION
KILN

Deactivation Kiln System

Floor Area	1,578㎡
Gross Floor Area	921㎡

Equipment Provided by US

- US provided APEs and New Technologies
- Consists of the followings
  - APE-1401: Meltout and Recovery
  - APE-2048: Flashing Furnace
  - APE-1028: Powder Collection System
  - Set of Disassembly Equipment
  - Supercritical Water Oxidation System
  - Molten Salt Oxidation System
  - Propellant Conversion System
  - Analytical Equipment

Explosive Recovery & Waste Treatment System

PCF and Support Facilities

Floor Area	1,826㎡

Timeline


Items
2006
2007
2008
1
2
3
4
1
2
3
4
1
2
3
4
Annex Negotiation
Construction
Equipment Installation
Test Run & Training
Start Operation

Conclusion

- ROK and US established mutually beneficial disposal policy to jointly demil the aging munitions.
- The DEFAC will be a comprehensive, non-polluting, closed-loop facility which will cost effectively demil various munitions.
- The operation of DEFAC will start in the second half of 2008. Any pertinent technical information for operation and generated data during operation will be shared.

US Army Corps
of Engineers

Coalition Munitions Clearance
(formerly called CEA)

U.S. Army Corps of Engineers
Huntsville Engineering & Support Center
Keith Angles (256) 895-1577
May 2006

Coalition Munitions Clearance
Formerly CEA

US Army Corps
of Engineers

- Customer – Multinational Corps Iraq (MNC-I) (formerly CJTF- 7):
- Conducted a site assessment in June/July 2003
- Identified customer requirements
  - Collection processes
  - Transportation to demolition areas
  - Demolition sites
- Provided the deliverables on 16 July 2003
  - Site assessment report
  - Civilian contractor scope of work
  - Cost estimates

Coalition Munitions Clearance
Formerly CEA

US Army Corps
of Engineers

- Strategy Metrics
  - CMC 100 t./day/depot + collapse UXO sites
  - 40,000 t./mo all sites
  - CEA behind the fence in Oct 04

Coalition Munitions Clearance

Formerly CEA

Mission Objectives

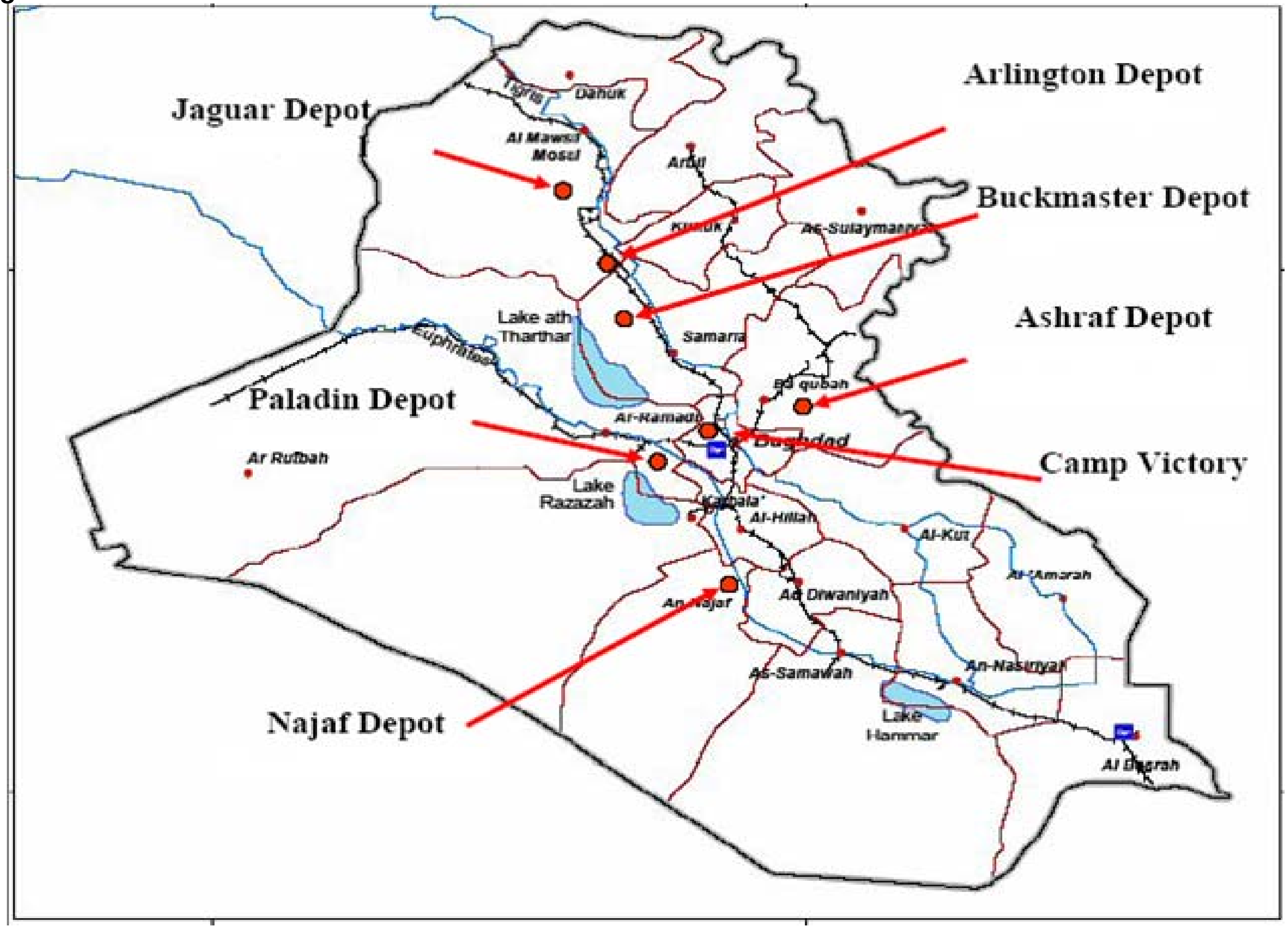
US Army Corps
of Engineers

Support Coalition forces

- Reduce/replace active military with Corps of Engineers/Contractor assets
- Provide "cradle to grave" CEA support services
- Maximize use of Iraqi labor/assets
- Be self sufficient
- Facilitate transfer to people of Iraq

Depot Operations

US Army Corps
of Engineers




000230 4356069


14 9:00 AM

Coalition Munitions Clearance

Formerly CEA

US Army Corps
of Engineers

- 5 Depots Have Been Closed
- Destroyed/Secured 412,000 Tons
- Initiated UXO Removal at numerous sites
- Fielded 20 mobile teams at 16 sites

Coalition Munitions Clearance

Formerly CEA

US Army Corps of Engineers

Schedule

• Funding Received	28 July 2003
• Contract Awarded	08 August 2003
• USACE Liaisons in Iraq	15 August 2003
• Advance Team in Iraq	28 August 2003
• Demolition Operations Begin	11 Sept. 2003
• Transfer to USACE	04 Dec. 2003
• Behind the fence	Fall 2004
• Complete Destruction of all CMC	Feb 2006
• UXO Mission	Ongoing
• Depot Ops Mission	Ongoing

Coalition Munitions Clearance
Formerly CEA
Present

US Army Corps of Engineers

- Finished CMC Demolition at Arlington
- Depot Ops at Arlington started
- Depot Ops at Buckmaster started
- Fielding 20 mobile teams for UXO removal

US Army Corps
of Engineers

Coalition Munitions Clearance

Formerly CEA

Current Manning

- As of 01 April 06
- CMC Personnel in theater
  - Contractor Personnel: 804
  - Government Personnel: 13
  - Local Hires: 747

Total: 1,564

Coalition Munitions Clearance

Formerly CEA

US Army Corps
of Engineers

Operations Status (15 Apr 06)

• Total tons destroyed by HNC/CMC	308,000
• Total tons secured in depots HNC/CMC	142
• Total tons destroyed/secured HNC/CMC	319,000
• Estimated tons destroyed by military	93,000
• Total tons	412,000

US Army Corps
of Engineers

Demo Shots/Burns

Coalition Munitions Clearance

Formerly CEA

Security

US Army Corps
of Engineers

- **Threat**
  - **Improvised Explosive Devises**
  - **Snipers**
  - **Ambushes**
- **Security Forces**
  - **Armored Vehicles**
  - **Contract Security**
- **Base security**
- **Convoy security**
  - **Personnel**
  - **Ammunition**


Security
IED Damage
No Casualties
11/11/2004

Coalition Munitions Clearance

US Army Corps
of Engineers

Casspir

•Armored vehicle, designed to protect against mine blasts and small arms fire.

•Crew of 2, and 12 additional soldiers.

•Used for transporting troops.

Coalition Munitions Clearance

US Army Corps of Engineers

Mamba Armored Personnel Carrier (APC)

- Armored vehicle, designed to protect against mine blasts and small arms fire.
- Crew of 2, and 9 additional soldiers.
- Used for rescue, command, transport, and logistics purposes.



Coalition Munitions Clearance

Formerly CEA

Future

US Army Corps of Engineers

- Continue Depot Ops
- UXO Removal

Questions

Demilitarization Developments in NATO

Presented to:
Global Demilitarization Symposium
Indianapolis
2 May 2006

Presented by:
Peter COURTNEY-GREEN
Chief, Ammunition Support Office
Operational Logistics Support Programme

NATO Maintenance and Supply Agency

NATO OTAN NAMSA

Location

Organization

North Atlantic Council

NAMSO
Board of Directors

NAMSA

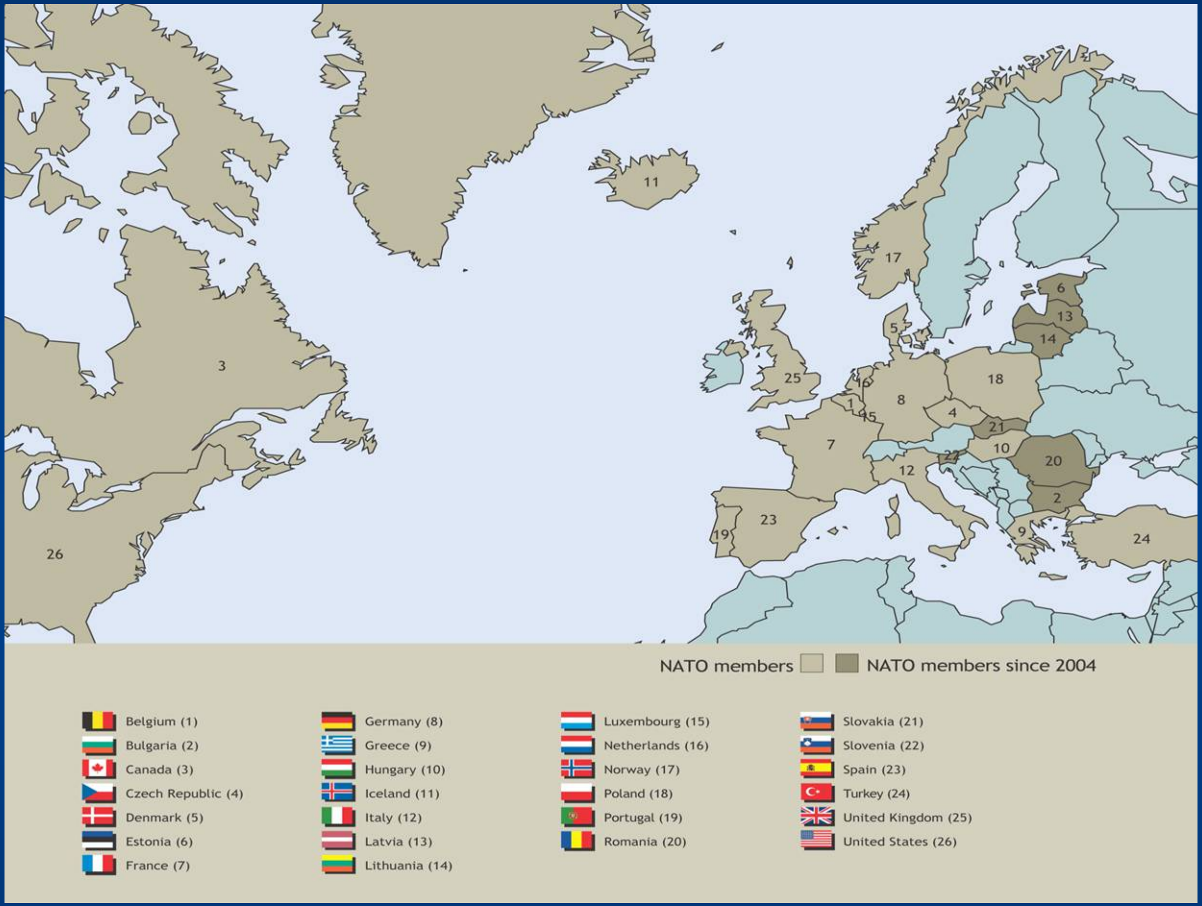
NATO's main logistics agency

Logistics support to Alliance operations

Logistics support to some 50 weapon systems (air, land, sea)

965 International staff | **25 nations** | **Chartered 1958**

NATO: Now 26 Countries



Poland, Hungary, Czech Republic joined NATO on 12 March 1999
Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovenia and Slovakia joined the Alliance on 29 March 2004

NATO Users of NAMSA Ammunition Services: Supply, Demilitarization, Services

Armies

- Belgium
- Denmark
- France
- Greece
- Italy
- Netherlands
- Norway
- Spain
- Turkey
- UK
- USA

Navies

- France
- Italy
- Netherlands
- Portugal
- Spain
- Turkey

Air Forces

- France
- Germany
- Italy
- Netherlands
- Portugal
- Spain
- Turkey
- UK
- USA

Partnership for Peace: Now 20 Countries

ALBANIA
ARMENIA
AUSTRIA
AZERBAIJAN
BELARUS
CROATIA
FINLAND
GEORGIA
IRELAND
KAZAKHSTAN

KYRGHYZ REPUBLIC
MOLDOVA
RUSSIA
SWEDEN
SWITZERLAND
TAJIKISTAN
The Former Yugoslav Republic of MACEDONIA (1)
TURKMENISTAN
UKRAINE
UZBEKISTAN

*** Turkey recognises the Republic of Macedonia by its constitutional name**

NATO PfP Trust Fund Policy

- Established in 2000 to provide mechanism to assist Partner nations meet Ottawa Convention obligations
- 2001 extended to include:
  - Small Arms and Light Weapons
  - All conventional munitions
- New Policy November 2002 extended to include:
  - Management of the consequences of defence reform, including but not limited to:
    - Civil and democratic reform of armed forces
    - Retraining military personnel
    - Base conversion
    - Defence planning
    - Budgeting under democratic control
- Now extended to include Mediterranean Dialogue countries: Algeria, Egypt, Israel, Jordan. Mauritania, Morocco and Tunisia

PfP Trust Fund Projects

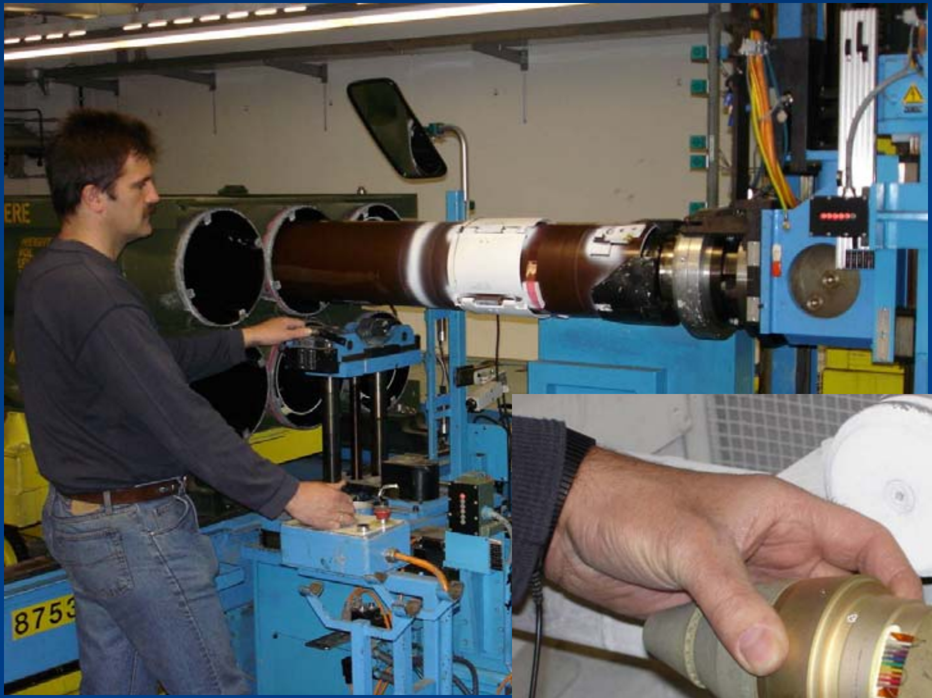
Project	Aim	Lead Nation	Cost	Status
Albania I	1.6 Million APL	CAN	USD 800,000	Completed Apr 02
Moldova	325 tonnes Melanj /12,000 APM	NLD	USD 1.129 M	Completed Dec 02
Ukraine I	400,000 APL	CAN	USD 800,000	Completed May 03
Serbia & Montenegro*	± 28,000 SALW	NLD	EUR 375,000	Completed Nov 03
Georgia	AA missile destruction (x 540)	LUX	EUR 1.254 M	Completed Mar 06
Albania II	± 11,000 tonnes SALW munitions	CAN	EUR 6.4 M	Started Dec 02
Serbia & Montenegro*	1.3 Million APL	CAN/AUT	EUR 1.7 M	Started Feb 05
Ukraine II	400,000 SALW / 1,000 MANPADS/ 15,000 tonnes munitions	USA	EUR 7.8 M	Started Dec 05
Azerbaijan	UXO Clearance	TUR	EUR 1.6 M	Started Nov 05
Belarus	700,000 APL	CAN	EUR 350,000	Started Dec 05
Moldova	± 1,700 tonnes Pesticides	BEL / ROU	EUR 840,000	Start est. May 06
Kazakhstan	30,000 SALW / 325 MANPADS	USA	EUR 260,000	Revised proposal submitted

Demilitarization Developments

What's new?

- MLRS demil under way in Europe
- Demil factory under construction in Turkey
- Plant under development to convert Melanj (IRFNA) to fertilizer
- Explosive Waste Incinerator (EWI) running 24/7 in Albania
- EWI's being procured for Turkey and Ukraine
- Azerbaijan tackling massive UXO clearance task
- Help needed to tackle 8,000 UXO's containing WP
- Work starting to clear huge Ukraine munitions surpluses

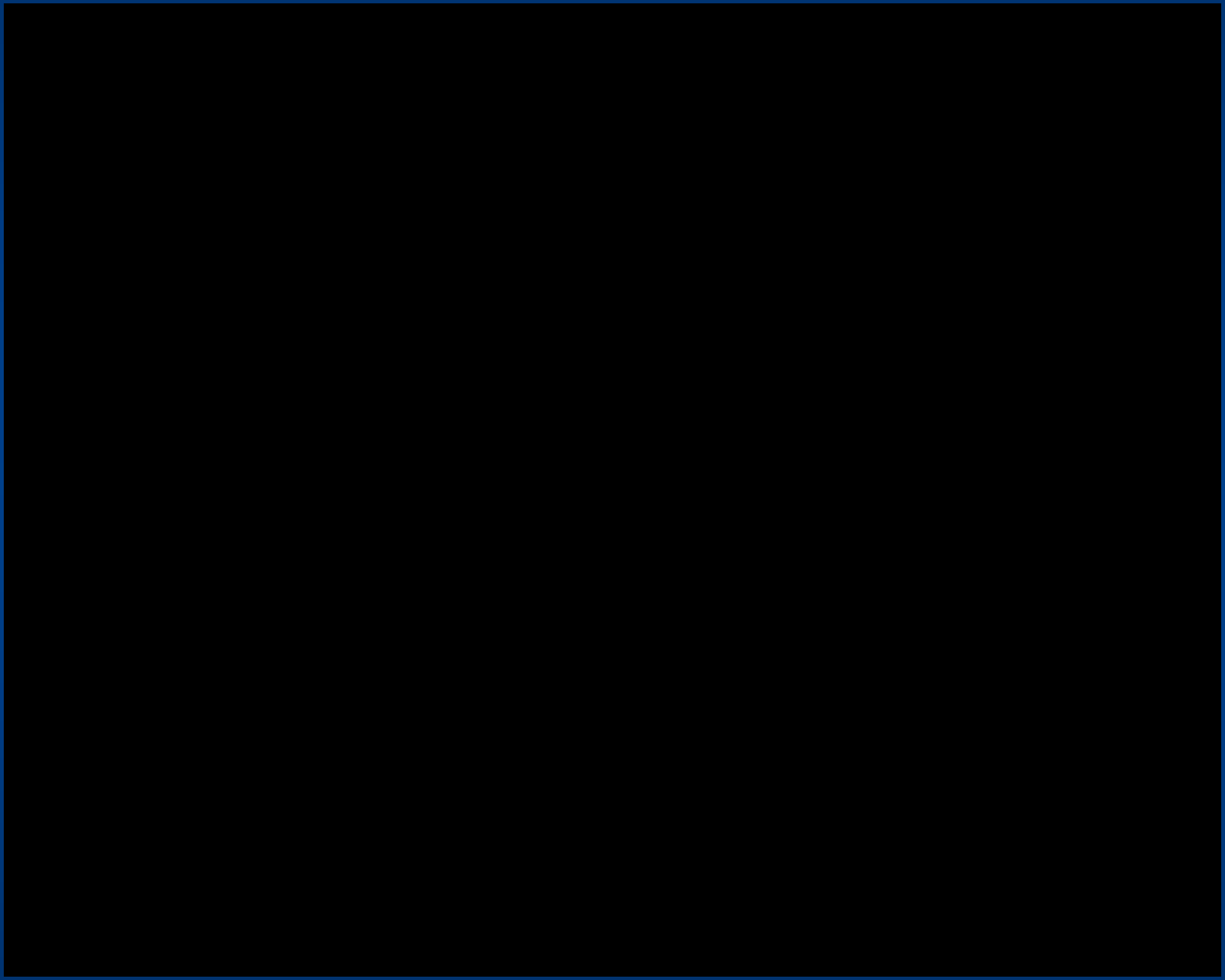
MLRS demil under way in Europe



Budgetary
ROM
Price
EUR 700

Work under way at Esplodenti Sabino (IT) and Diehl (GE)

Demil factory under construction in Turkey



Plant under development to convert Melanj (IRFNA) to fertilizer

Moldova: Melanj destroyed by incineration by UK/US/Ukraine consortium

Melanj problem exists in most FSU countries
Conversion plant under construction in Istanbul
US company is prime contractor
Will be commissioned at Älät, Azerbaijan in early July 2006
1,200 tonnes to be converted at 2 sites in Azerbaijan
Ready for deployment elsewhere early in 2007

Explosive Waste Incinerator (EWI) running 24/7 in Albania

Armoured Rotary Kiln

Pollution Abatement System

Gas Cooler

Cyclone

Bag House

Currently destroying ~2 million small arms cartridges every week. Productivity steadily improving

NATO OTAN NAMSA

Flashing 14.5 mm Ammunition After Incineration

Next challenge: Chinese 14.5 mm API carts

EWI’s being procured for Turkey and Ukraine

STATEMENT OF WORK

PROVISION, INSTALLATION AND COMMISSIONING OF A ROTARY KILN EXPLOSIVE WASTE INCINERATOR FOR UKRAINE

Prepared by
NATO MAINTENANCE AND SUPPLY AGENCY
OPERATIONAL LOGISTICS SUPPORT PROGRAMME
AMMUNITION SUPPORT OFFICE

STATEMENT OF WORK

PROVISION, INSTALLATION AND COMMISSIONING OF A ROTARY KILN EXPLOSIVE WASTE INCINERATOR FOR TURKEY

Awarded

Prepared by
NATO MAINTENANCE AND SUPPLY AGENCY
OPERATIONAL LOGISTICS SUPPORT PROGRAMME
AMMUNITION SUPPORT OFFICE

Azerbaijan tackling massive UXO clearance task

Azerbaijan tackling massive UXO clearance task

Azerbaijan tackling massive UXO clearance task

Newly Qualified Azerbaijan UXO Clearance Workers

Azerbaijan: help needed to tackle 8,000 UXO's containing White Phosphorus

Open detonation time consuming, expensive in explosive charges, high degree of contamination

Too dangerous to move to a factory

Need a simple, safe mobile plant…

Azerbaijan: help needed to tackle 8,000 UXO's containing White Phosphorus

Holes drilled in base of shell

Need a compact, mobile, rugged version for use in the field

Hot water tank

Projectiles in hot water tank

NAMSA will issue a Request for Proposals

Empty projectiles

Work starting to clear huge Ukraine munitions surpluses

First 3 year phase of 12 year project to destroy surplus weapons, munitions and MANPADS

Lead Nation: USA

Contributors: Bulgaria, Canada, EU, Lithuania, Luxembourg, Norway Slovakia, Switzerland, Turkey, Austria, Germany, Netherlands, UK, US

Ukraine munitions surpluses

What do 2 million tonnes of ammo look like?

100,000 x 20 tonne trucks with 40 metres between each truck: convoy would stretch 5,000 kms (3,100 miles)

What do 2 million tonnes of ammo look like?

100,000 x 20 tonne trucks with 40 metres between each truck: convoy would stretch 5,000 kms (3,100 miles)

Major Accidents Occur Every Year

Major Russian Highway Sealed Off After Arms Depot Explosion

A major highway connecting Moscow and the Ukrainian city of city of Simferopol was closed after explosions tore through an arms depot in south Ukraine on Thursday, sending ammunition and shrapnel flying across a 10-km (six-mile) radius and prompting the evacuation of nearly 10,000 residents, Russian media reported.

There are varying reports on casualties: several Russian agencies have said there were numerous casualties, without naming the figures, while Reuters, citing the Emergency Ministry, has said no casualties have been reported.

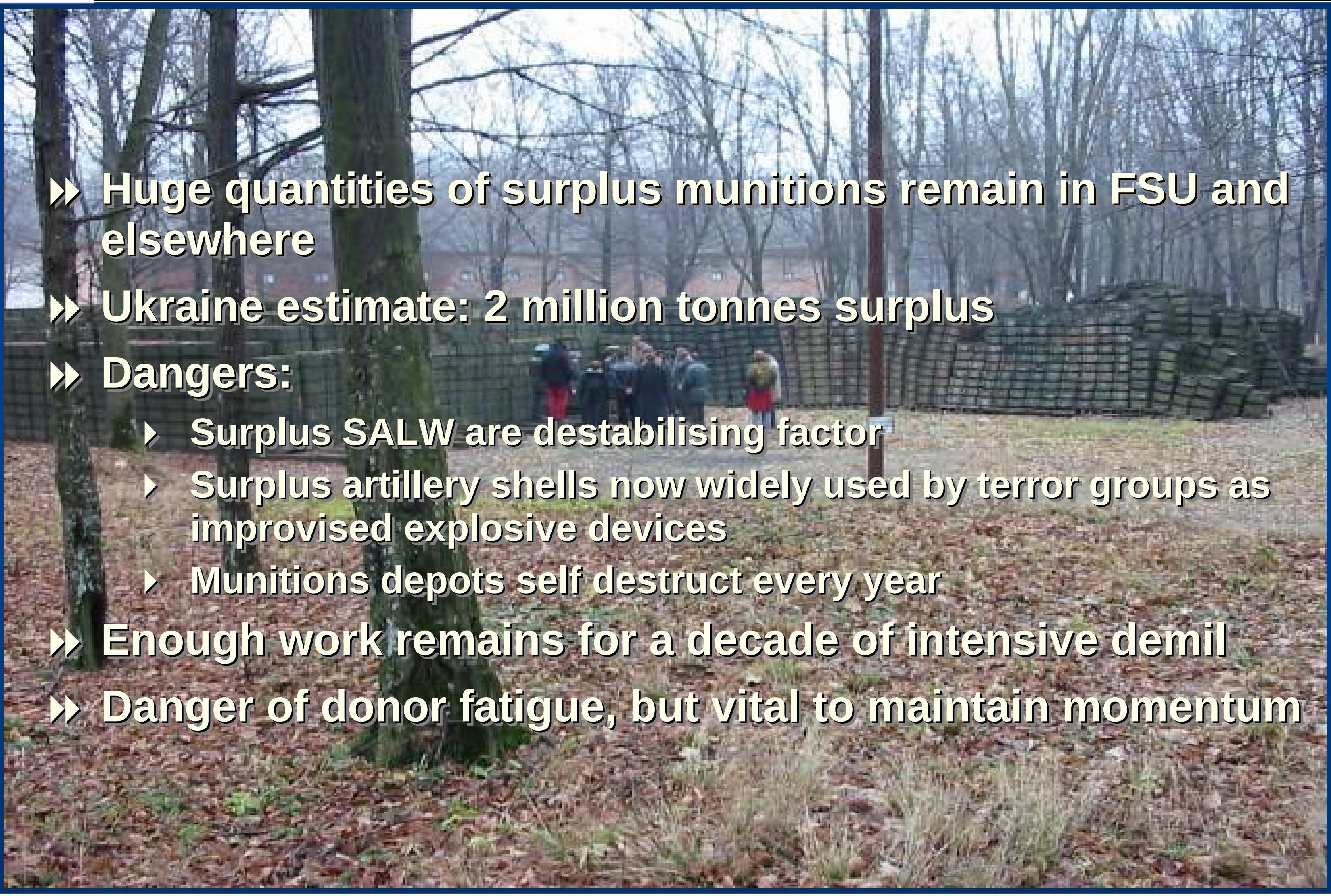
No Russian casualties have been reported so far, although some of the towns that were evacuated are close to the Russian border west of the region.

"A fire broke out at Defense Ministry warehouses near Novobohdanivka village, where large amounts of ammunition were stored. The ammunition then detonated," ministry spokesman Oleh Oleksandriv told Reuters.

Reuters quoted Oleksandriv as saying that metal shards had been catapulted over a

NATO OTAN NAMSA

Future Demil Work for PfP Trust Fund



- **Huge quantities of surplus munitions remain in FSU and elsewhere**
- **Ukraine estimate: 2 million tonnes surplus**
- **Dangers:**
  - **Surplus SALW are destabilising factor**
  - **Surplus artillery shells now widely used by terror groups as improvised explosive devices**
  - **Munitions depots self destruct every year**
- **Enough work remains for a decade of intensive demil**
- **Danger of donor fatigue, but vital to maintain momentum**

Explosives Safety Aspects of Demilitarization

Lyn Little
James Hammonds
USATCES
SJMAC-EST
lyn.little@us.army.mil
james.hammonds@us.army.mil

JMC – On the Line

Introduction

- Historically ammunition demilitarization has been a significant safety challenge
  - Army explosives accident database shows this to be one of our highest risk operations
  - Initiating an inherently hazardous product
  - Generally accidents are catastrophic
- New demilitarization technologies can add new and unique explosives safety challenges
  - New methodologies with no history or limited data
  - Unknown failure rates
- Safety involvement at project inception is essential

Explosives Safety Considerations

- ✓ Hazards analysis/Risk assessment
  - ➢ Continual updating is essential
- ✓ Operator protection
- ✓ Initiation sensitivities of the explosives
- ✓ Site planning
- ✓ Dust/vapor hazards
- ✓ Lightning protection
- ✓ Insure controls are implemented
- ✓ Start early in concept stage

Risk Assessment

- DA Pamphlet 385-64, Chapter 2 requires a hazards analysis and risk assessment
  - The assessment will review such factors as—
    - Initiation sensitivity
    - Quantity of materials
    - Heat output
    - Rate of burning
    - Potential ignition and initiation sources
    - Protection capabilities of shields, various types of clothing, and fire protection systems
    - The acute and chronic health hazards of hot vapors and combustion products on exposed personnel.

Operator Protection

- ✓ DA Pamphlet 385-64 requires protection of personnel from overpressures above 2.3 psi, fragments with an energy above 58 ft/lbs, and thermal effects when the risk assessment identifies risk above an acceptable level
- ✓ Mil-Std 398 shielding provides equivalent or greater protection

Initiation Sensitivities

- ✓ New technologies must be reviewed to determine the levels of process energy being imparted
- ✓ Early planning is beneficial
- ✓ Testing provides useful data

Site Planning

- ✓ Is a new facility being used?
  - ➢ Site plan is required
- ✓ Has an existing facility been used for similar operations in the past?
  - ➢ If not, site plan is required
- ✓ Does it increase the net explosives weight involved?
  - ➢ If so, site plan is required

Dust/Vapor Hazards

- ✓ Does the proposed process introduce dust or vapor hazards?
  - ➢ "Explosion proof" wiring, switches, fixtures will be required
- ✓ Electrical equipment listed by UL or FM required unless certified by a qualified safety engineer
- ✓ Bonding/grounding required IAW Chapter 6 of DA Pamphlet 385-64

Lightning Protection

- ✓ Lightning protection required IAW Chapters 6 and 12 of DA Pamphlet 385-64 and NFPA 780
  - ➢ Unless requirements of Para 12-4 are met.
- ✓ Systems must meet 100 foot striking arc requirement

Summary

✓ Demilitarization operations can add new and unique explosives safety challenges

✓ Safety involvement at project inception is essential

✓ USATCES is available as a resource/tool to provide assistance in dealing with these challenges

  ➢ "The earlier the better"

Material Potentially Presenting an Explosive Hazard (MPPEH)

2006 Global Demilitarization Symposium

INDIANAPOLIS IN

2-5 May 2006

Presented by Mr. Samuel Dallstream

Management and Disposal of MPPEH
2006 Global Demilitarization Symposium

Goal is effective MPPEH program.

One Process Owner For Demilitarization and Disposal of MPPEH

Closed Circuit process for control, accountability, tracking and process

Management and Disposal of MPPEH
2006 Global Demilitarization Symposium

The DOD policy is intended to safely demilitarize and dispose of residue while complying with the Military Munitions Rule.

MPPEH is Debris; Junk; Scrap; Excess Material; UXO, Containers and Packaging associated with military munitions.

MPPEH is US government property.

MPPEH is a subset of AEDA. AEDA is MPPEH, radioactive material, compressed gas, pesticides, other hazardous material

Areas of High Concern

Explosion

Death or Injury

Responsibility

Liability

Control

MPPEH Explosive Safety is a concern for all services

$$$ - Money - $$$

- MPPEH from ammunition use is located on Ranges, at the ASP, TOE Units, test facilities is usually derived from used munitions. Installation funds most of the demilitarization and disposal cost.

- MPPEH from Manufacture, depots, surveillance, maintenance lines, is usually new or stored munitions. Demilitarization is funded by ammunition procurement funds.

Management and Disposal of MPPEH



Management and Disposal of MPPEH
***2006* Global Demilitarization Symposium**

- MPPEH requires a special management process to make sure it is recycled or disposed of safely. RCRA with the Military Munitions Rule state when this material becomes a waste and how it is to be stored transported and disposed. The RCRA clauses for recycling and reuse are important to managing MPPEH.

Material found OFF Range Can be a Hazardous waste

Designated Disposition Authority (DDA) Authorized Military Official (AMO)

Evaluation Process for Returns

Condition Codes

R3

Management

Management and Disposal of MPPEH
2006 Global Demilitarization Symposium

- **The DoDI 4140.62 requires DDESB explosive site plans for Formerly Used Defense Sites (FUDS).**
- **The DoDI 4140.62 sets guidance for explosive workers, and closed-circuit process for munitions related debris.**

Management and Disposal of MPPEH
2006 Global Demilitarization Symposium

- The 4140.62 DoDI responsibilities and procedures; chapter five and six; cover major services in a contract; i.e. sorting, collecting, marking, inspection, demilitarization, transport, crushing, flashing, disposal, and documentation of munitions related material.
- Army Environmental Center's MPPEH survey and study underway. Best Practices, Cost Analysis and Recommendations for MPPEH manual.

Management and Disposal of MPPEH
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DoD and Army publication sources for MPPEH in Revision:

- DoD 4140.62 MPPEH
- DoD 4160.21-M Disposal
- DoD 4160.21-M-1 Demilitarization
- DoD 6055.9-STD Explosive Standards
- DoD 4145.26-M Explosive contractors
- Qualified Recycling Program Guide
- JCAPP, Chapter 7; replaces chapter in SMCA manual

- AR 75-1 Malfunctions
- AR 385-63 Range Safety
- AR 385-64 moving into AR 385-10
- PAM 385-63 Range Safety
- PAM 385-64 Explosive Safety

MPPEH What is Success

- Measurement is short tons demilitarized and disposed
  - Effective = short tons disposed
  - Efficient = cost per short ton
- Safe Storage – must always maintain a “GO”
- Operational Ranges are Sustained for Training

Questions?

Implementation of Design for Demil (DFD) in the Joint Services

14th Annual Global Demil Symposium and Exhibition
Indianapolis, IN

1 - 5 May, 2006

Mr. Gary Mescavage
ARDEC - Picatinny Arsenal, NJ

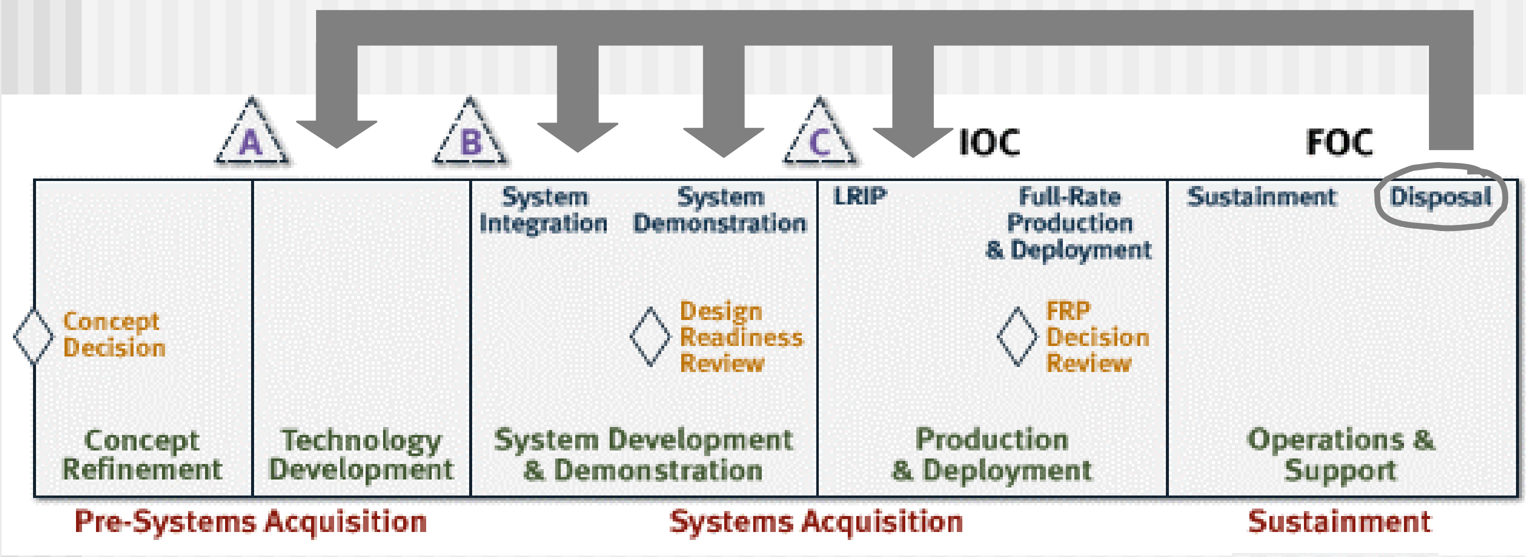
Presentation Outline

- The DFD Goal
- Why DFD?
- Implementation Strategy
- Challenges
- IPT Activity
- Conclusion

Design for Demil

Goal

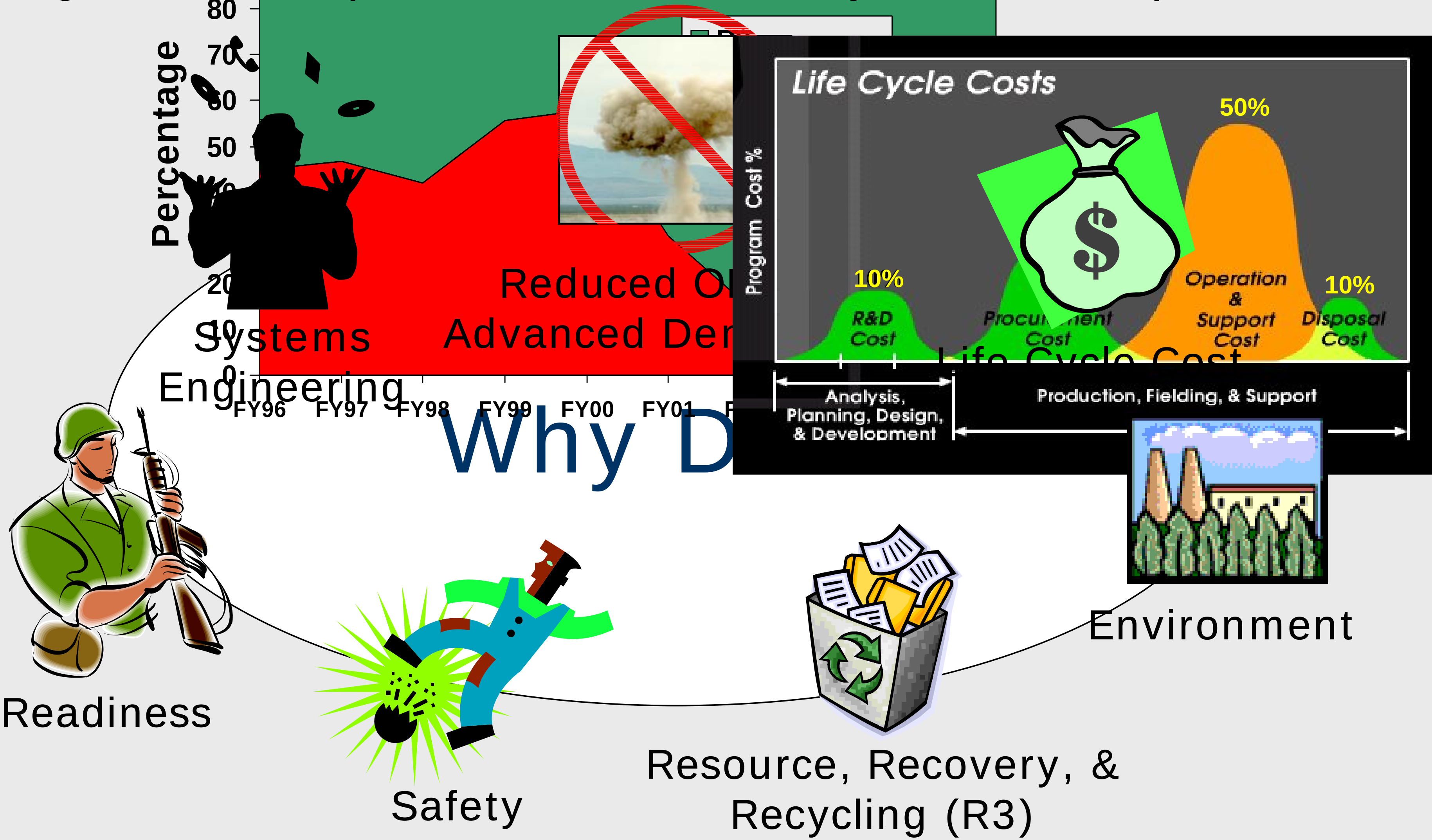
- Demil is a life cycle requirement that typically is inadequately addressed in the design phase.
- Goal: Influence munitions design early in the life cycle to incorporate demil considerations & positively impact future demil execution.



Why Design for Demil?

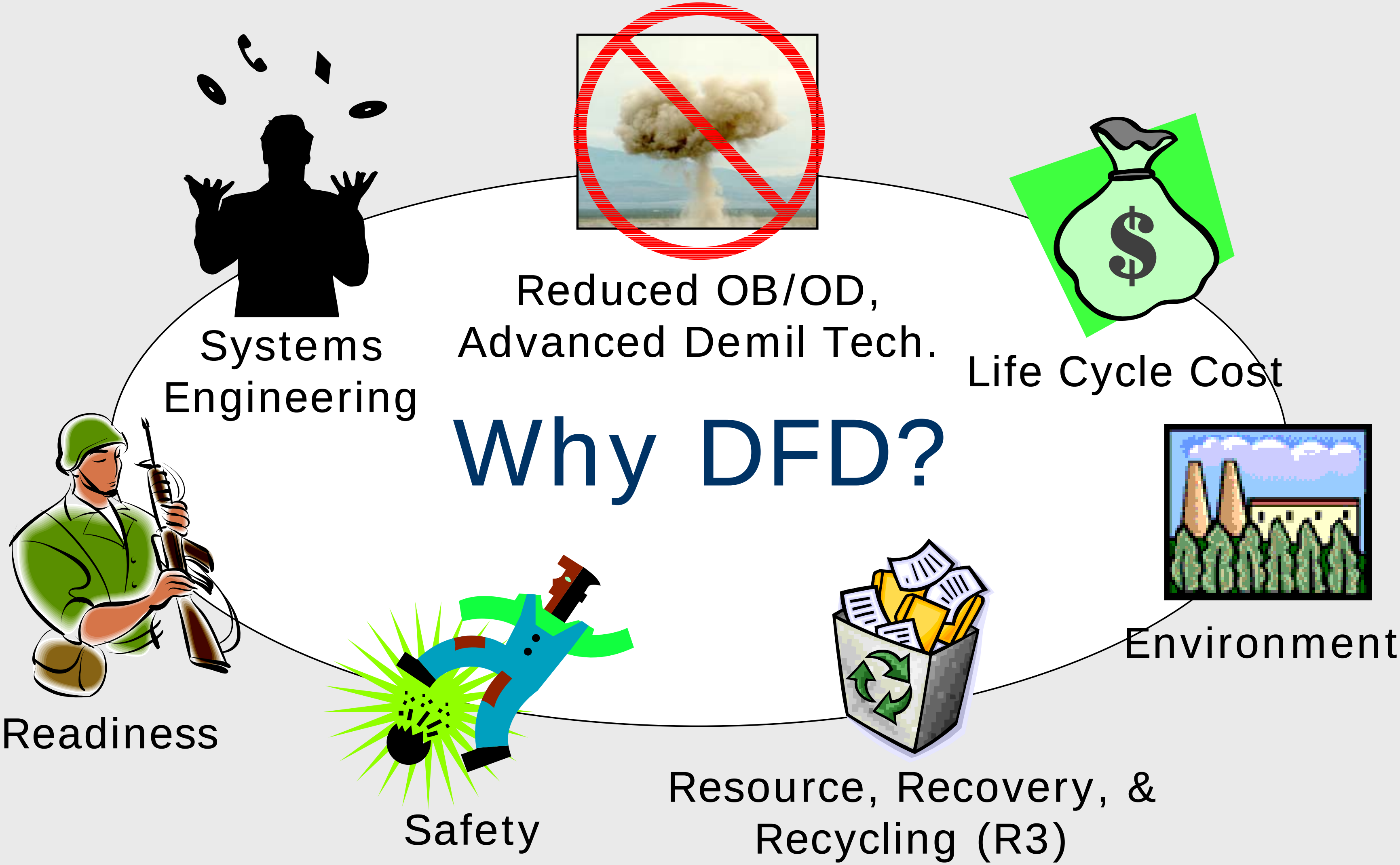
- Traditionally, munition designers focus on item performance & may not be aware that design decisions can lead to difficult demil problems at the end of the item's life cycle.
- In the past, OB/OD "took care of the problem".
- *Munition design historically had little impact on the ability to conduct effective and efficient demil (OB/OD).*
- But things have changed …


Design decisions made early in the life cycle now have a significant impact on end of life cycle demil operations!



DFD is a proactive approach to addressing future demil challenges.

Design decisions made early in the life cycle now have a significant impact on end of life cycle demil operations!



DFD is a proactive approach to addressing future demil challenges.

Design for Demil Policy

DoDI, 5000.2

At the end of its useful life, a system shall be demilitarized and disposed in accordance with all legal and regulatory requirements and policy relating to safety (including explosives safety), security, and the environment. **During the design process**, PMs shall document hazardous materials contained in the system, and shall **estimate and plan for the system's demilitarization and safe disposal**.

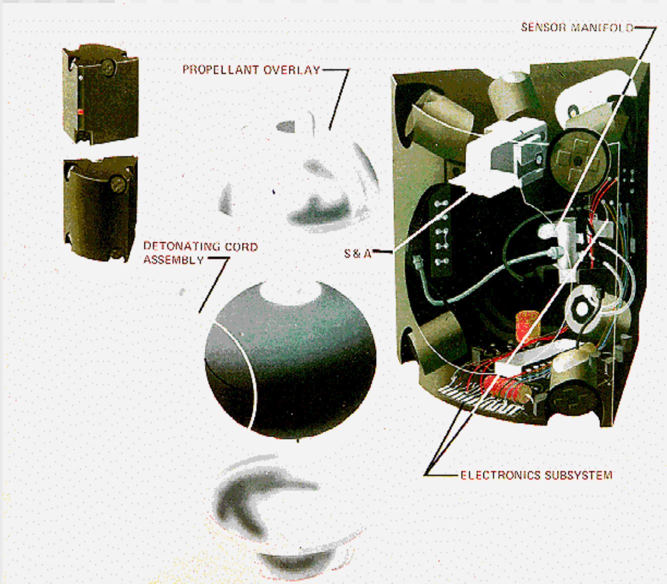
AMC-R 75-2/NAVSEAINST 8027.2A/AFLCR 136-5/ MARCORSYSCOMO 8020.1

Purpose: "... to the maximum extent possible, ammunition be designed for demilitarization and also requires the development of a formal demilitarization plan ...."

Design Impact on Demil

ADAM MINE

A depleted uranium (DU) salt in the molding compound is requiring $700K of additional equipment for the demil process.



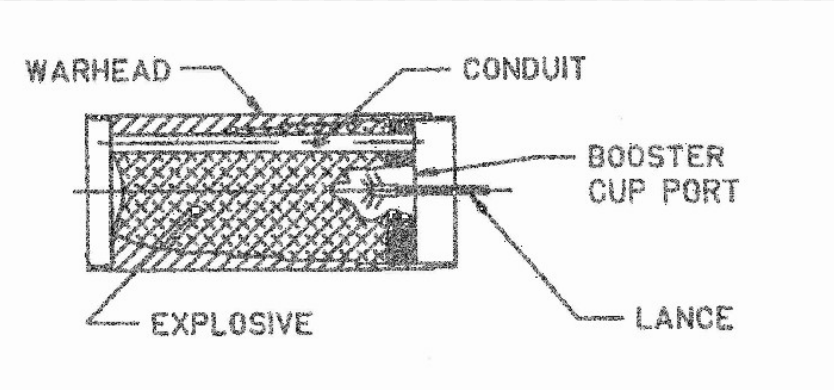
MINE FOR M692/M731 (ADAM)

SUP CHARGE

No glue … easier disassembly!

HARM WDU-21B NAVY WARHEAD

Smaller fill hole makes washout more difficult in WDU-37B Improved HARM; internal conduit traps explosives; PBXN-107 loaded binder does not melt.

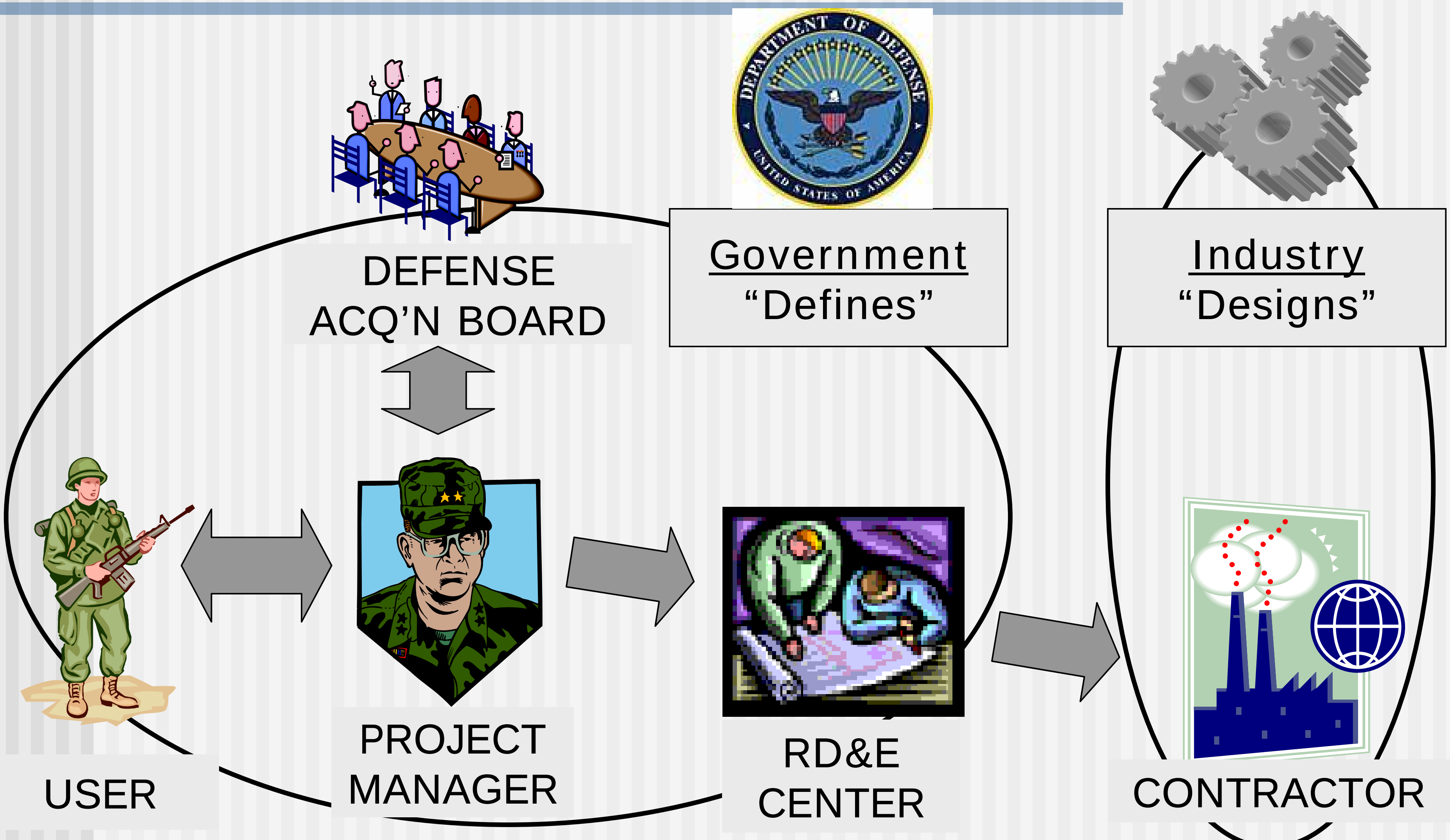


CROSS SECTION OF WARHEAD SHOWING ACTION OF WATER SPRAY

Design for Demil Implementation

- DFD a key strategic goal of the PEO Ammo approved PM Demil Strategic Plan.
- Multi-Service DFD Integrated Process Team (IPT) chartered to establish a DFD program.
  - Acquisition and demil are represented

Acquisition Players



DFD Challenges

- Design is predominantly driven by performance requirements and constrained by cost and schedule.
- Munition development Project Manager (PM) does not pay for demil.
- Demil doesn’t occur for 10+ years after an item is fielded.
- PMs aren’t aware of the need to DFD.

Item Performance

- Design for Demil is not intended to detract from achieving item performance.
- Design trade offs will be handled by the Item PM.
- Low cost design changes that do not impact performance could be made … if someone were thinking demil.

Demil Plan vs Design for Demil

Demil Plan ≠ Design for Demil

Demil Plan

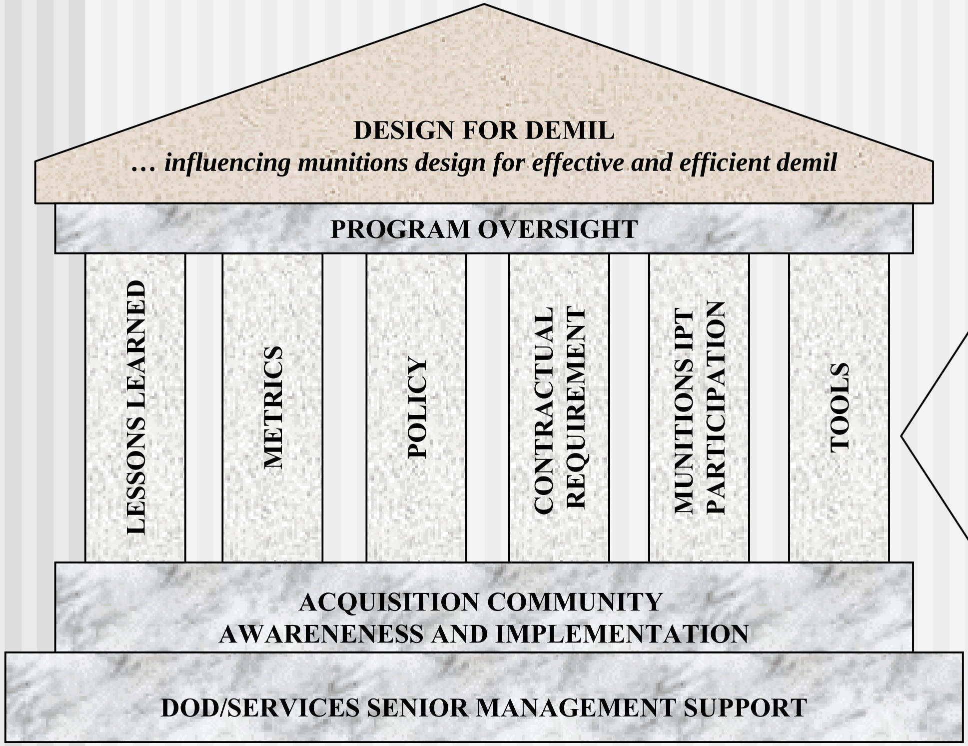
- Typically done late in the design
- Prescribes a procedure for demil
- Afterthought
- Reactive

Design for Demil

- Done throughout design
- Influences the design for efficient demil
- Forethought
- Proactive

Demil Plans can encourage but do not assure design for demil!

DFD Essential Program Elements

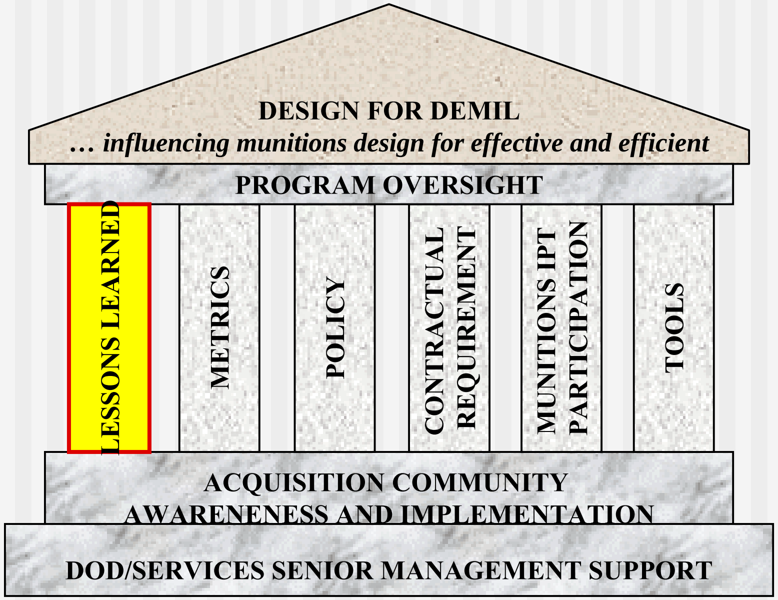


- *Lessons Learned:* *Design recommendations from demil execution experience*
- *Metrics: Verify accomplishment.*
- *Policy: Impose the requirement*
- *Contractual Requirement: Translate the requirement to the defense contractor.*
- *Munitions IPT Participation: Get involved "In the trenches".*
- *Tools: Provide practical help (web based handbook).*

Lessons Learned

Goal: Develop munitions design recommendations from demil execution experience.

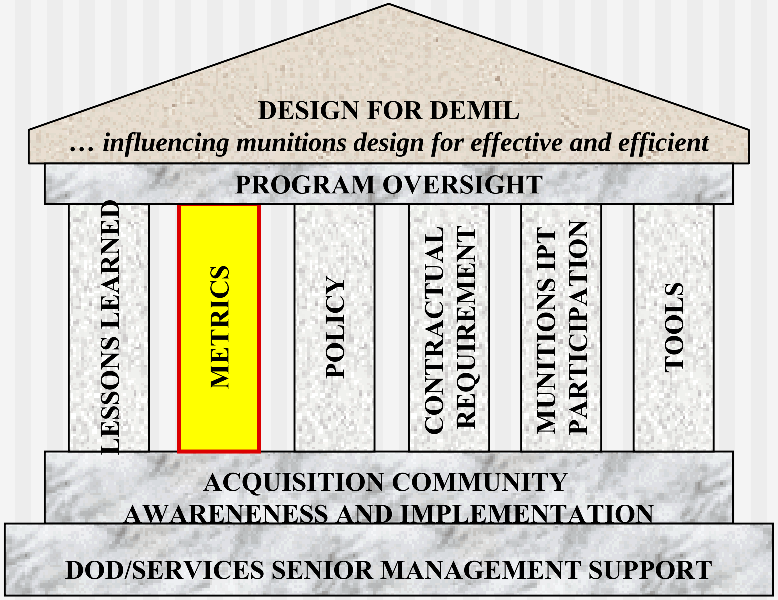
- Initial site visits conducted
- Six Sigma project initiated
  - Identify "good" demil
  - Evaluate demil processes
  - Identify design "flaws"



Metrics

Goal: Develop measurable criteria to evaluate achievement of DFD.

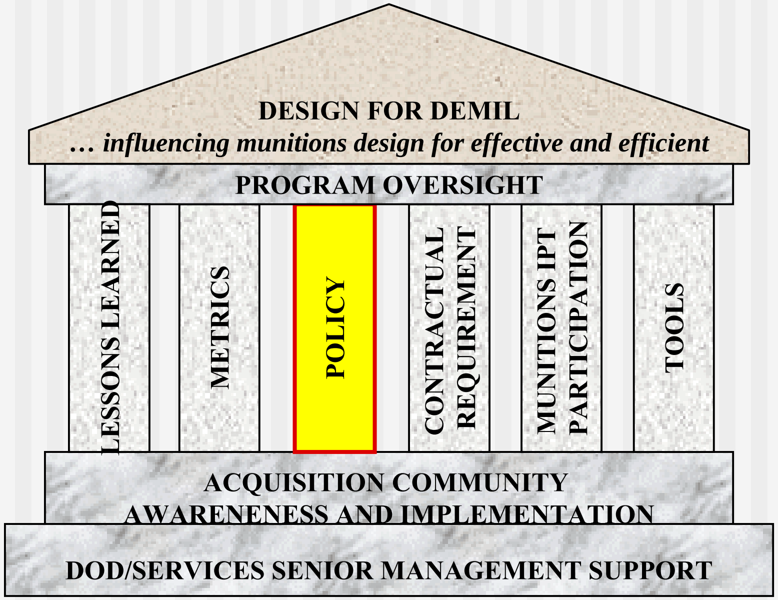
- Evaluated several metrics concepts
- Currently identifying DFD goals
- Metrics to be linked directly to goals



Policy

Goal: Implement enforceable policy (“teeth”).

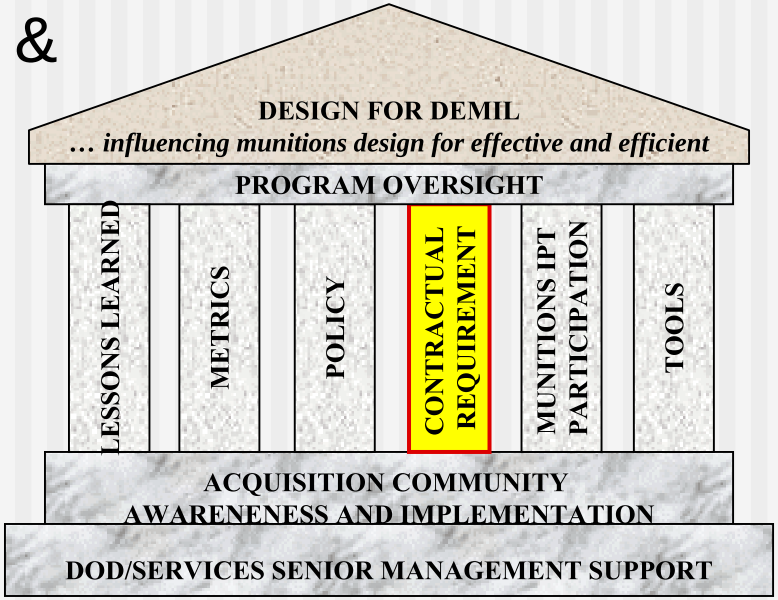
- Included DFD in the “Joint Reg”
- Identified needed policy:
  - DoD acquisition reg (5000)
  - Service acquisition reg
  - Milestone check
  - Logistics & other regs
- Need clear definition of the requirement first



Contractual Requirement

Goal: Define and articulate a clear requirement.

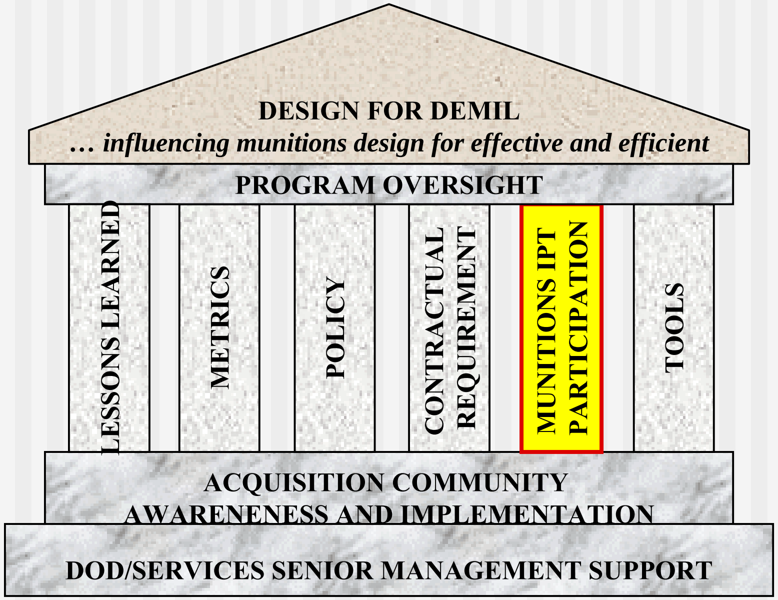
- Contract language defines & limits scope of effort
- Requirement in development
  - Benchmark other disciplines
  - Incorporate metrics
  - Define deliverables
  - Capitalize on IPT experience
  - Tap acquisition community



Munitions IPT Participation

Goal: Provide "real time" guidance and review to munitions development programs.

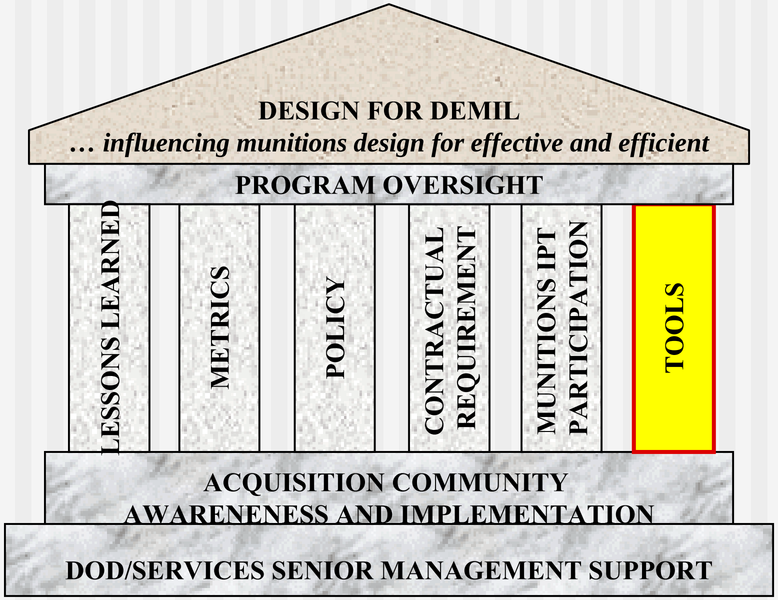
- Currently participating in ARDEC IPTs; more forthcoming
- Direct participation not always possible; may need a "help line"



Tools

Goal: Provide practical help to assist munition designers

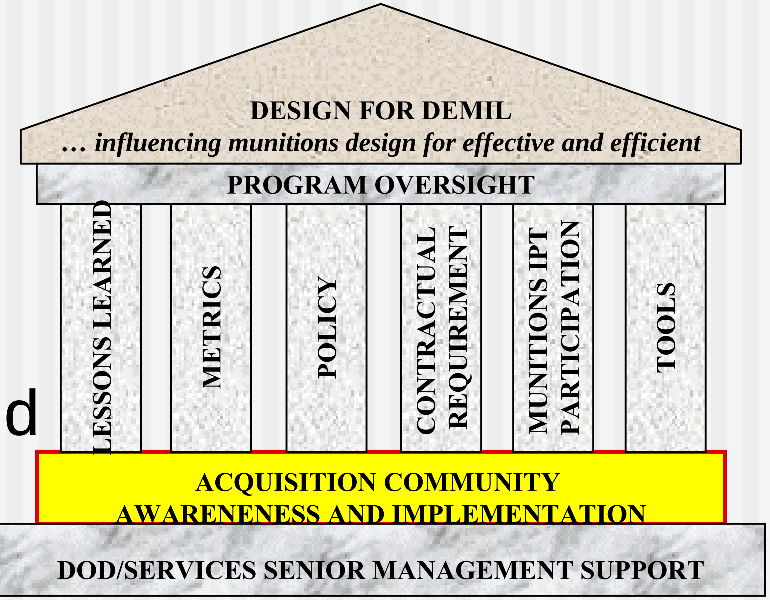
- Identified potential tools:
  - Handbook
  - Design analysis
  - Demil cost estimator
- Initiated handbook development
- Have a design analysis concept



Acquisition Community Awareness

Goal: Inform and educate the Joint Services acquisition community

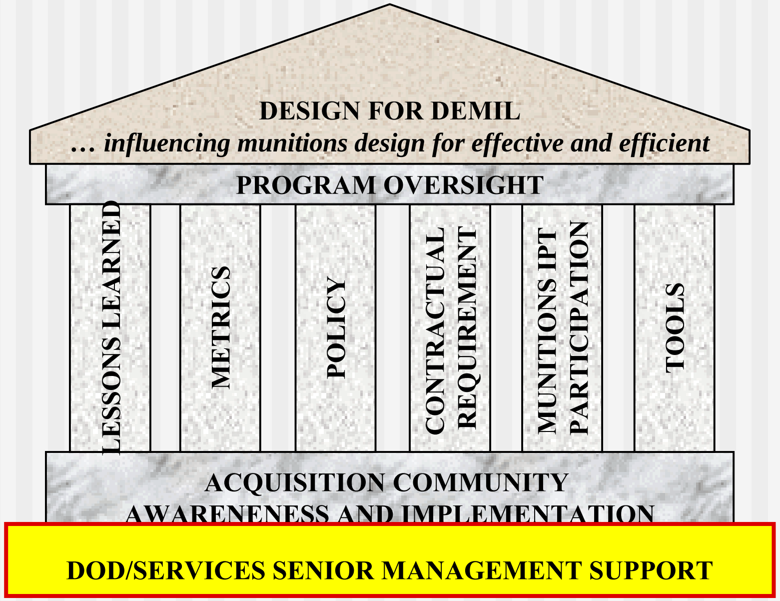
- "Demil Days" conducted:
  - Air Armament Center, Eglin AFB, FL
  - Naval Air Weapons Station, China Lake, CA
- Additional outreach planned
  - Acquisition courses, munitions conferences, articles & publications, Services outreach, etc.



DOD/Services Senior Management Support

Goal: Secure support of DoD/Services Senior Leadership

- DFD concept briefed by PM Demil to Services and DoD level leadership and is well supported
- Continue outreach

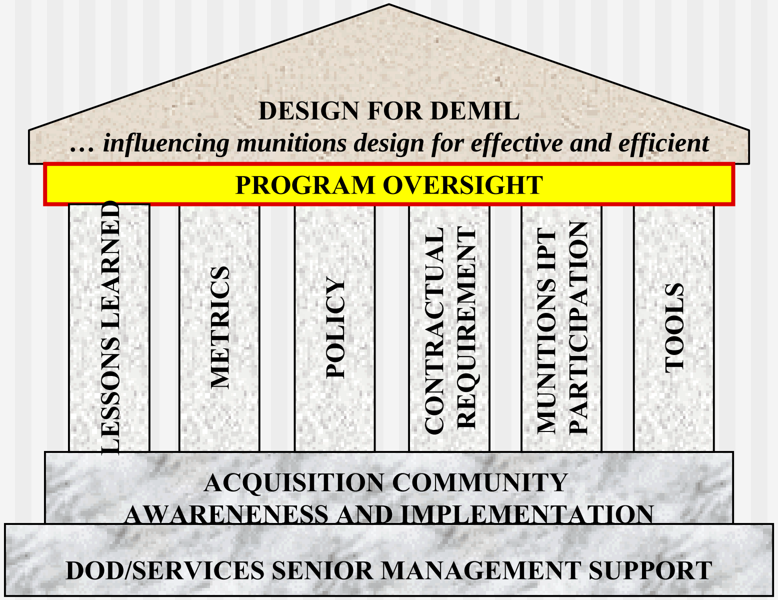


Program Oversight

Goal: Assure coordinated and relevant program development.

- Program oversight provided by PM Demil Office

- Execution oversight through the DFD IPT



DFD is Achievable!

- Forethought during the munitions design process can positively impact the demil legacy left behind, with little cost or performance impact.
  - ✓ Fulfills systems engineering approach
  - ✓ Enhance future Warfighter readiness
  - ✓ Facilitate demil stockpile reduction goals
  - ✓ Control life cycle cost
  - ✓ Avoid intractable demil problems (e.g. ADAM Mine)
  - ✓ Provide a future source of supply for new munitions
  - ✓ Enhance the Army's environmental stewardship
  - ✓ Maintain and enhance safety
- The Multi-Service program being developed through the PM Demil DFD IPT will provide strategic influence to assure effective DFD.

Demil Research & Development Integrated Product Team

Global Demil Symposium

and Exhibition – Indianapolis, IN

1-5 May 2006

Larry Nortunen
DRD IPT Lead
Defense Ammunition Center
918.420.8093

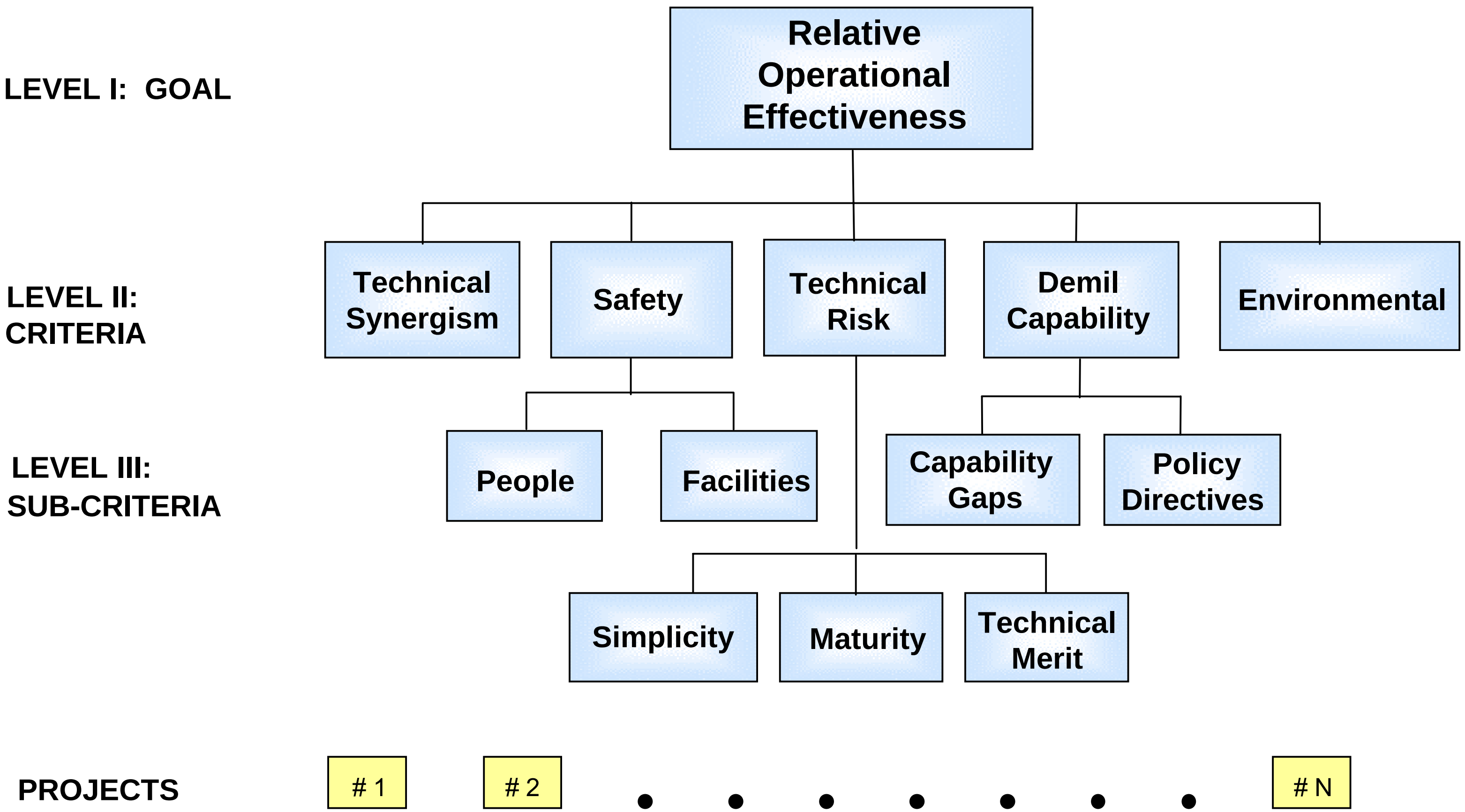
Outline

- DRD IPT Charter
- Evaluation Process
- Evaluation Results
- Demil R&D Master Plan
- Schedule
- Metrics
- Summary

DRD IPT Charter

- Purpose – make recommendations to the PM Demil for obtaining and allocating resources to support selection of Demil R&D projects
- Team Taskings:
  - ✓ Develop and document a project prioritization process; integrate with POM process
  - ✓ Develop a Demil R&D Technology Master Plan (update annually)
  - ✓ Develop R&D project performance measurement process
  - ✓ Serve as an advisory body to PM Demil
- Team Guidelines:
  - ✓ Focus on customer requirements
  - ✓ Identify R&D solutions to Demil Capability Gaps
- Revised 25 April 2006

DRD Decision Hierarchy Using AHP



Level I Goal Definition

Determine relative effectiveness of Demil R&D Technology Projects to maximize stockpile reduction capability within the constraints of environmental regulations, environmental stewardship, and safe demil work conditions while mitigating technical risks and promoting technical synergism.

Level II Criteria Definitions

Technical Synergism: The degree to which a project enables, enhances, or provides flexibility to other technologies or demilitarization operations, or other conventional ammunition life cycle operations.

Safety: With regard to fielded technologies, the degree to which a project minimizes the risk to people or facilities.

Demil Capability: The degree to which a project applies to a portion of the stockpile that currently does not have a technological solution.

Environmental: With regard to fielded technologies, the degree to which the proposed project resolves environmental constraints.

Technical Risk: The degree to which technical merit, maturity and complexity impact implementation.

Level III Sub Criteria Defs

<u>Safety</u> - People: The enhancement of personnel safety through the reduction of the probability of injury of death (with regard to fielded technologies).

<u>Safety</u> - Facilities: The enhancement of protection through the reduction of the probability or the consequences of mishaps to facilities, equipment or assets (with regard to fielded technologies).

<u>Technical Risk</u> - Simplicity: Number of subsystems and linkages between subsystems within the project.

<u>Technical Risk</u> - Maturity: Technology Readiness Level (TRL).

<u>Technical Risk</u> - Technical Merit: Degree to which the project is supported by sound scientific and engineering principles and experimental data.

<u>Demil Capability:</u> - Policy Directives: e.g, % CDT, PM Demil Strategic Plan Long Term Goals, International Agreements, State/Regional Influence.

<u>Demil Capability:</u> - Capability Gaps: No demil capability exists.

Demil Capability Gaps

- Ammonium Perchlorate (AP) Propellant
- White Phosphorus (WP) Felt Pads
- Red Phosphorus
- Plasticized White Phosphorus
- 40mm HEDP Grenades
- Depleted Uranium
- Pressed Energetics
- Cast-Cured Energetics

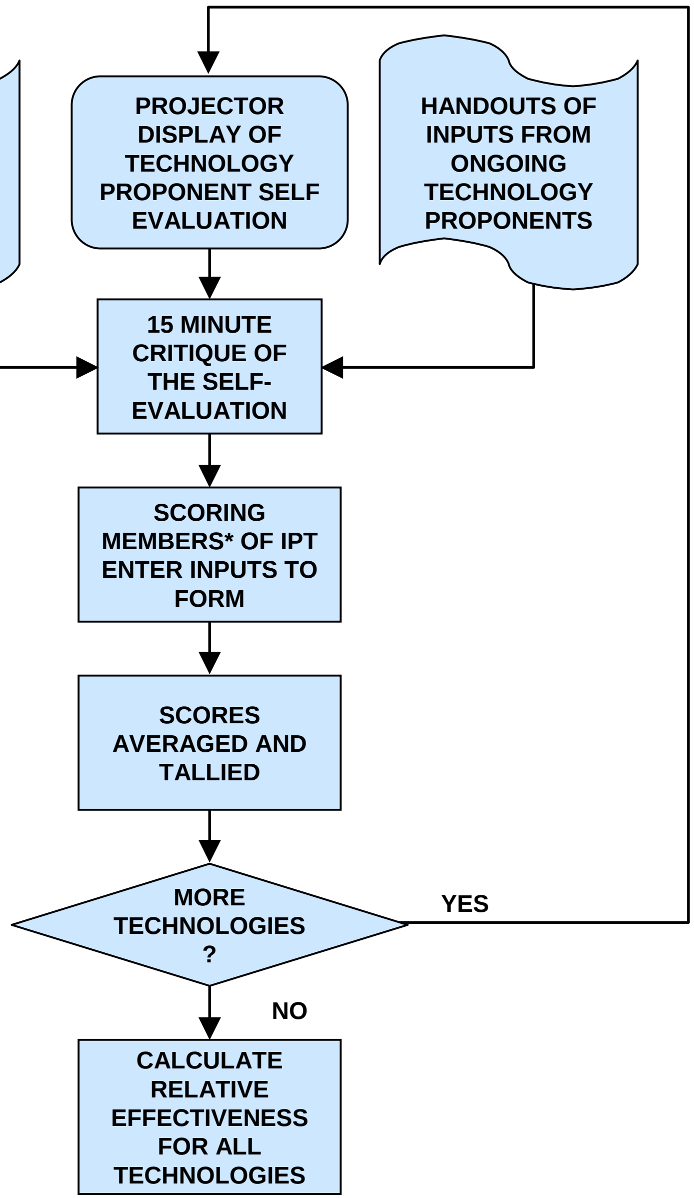
Technology Data Call

<u>Technology Project Information Workbook:</u>

- Technology Description / Proponents
- Operations and Schedule
- Technology Effectiveness*
- R&D Cost Summary
- Facilitization Cost
- Cost Savings

* Self Evaluation

Scoring Process for DRD Projects



* Scoring Members:

- Environmental
- Technical Ammunition
- Technical Science Advisor
- D51 Technology
- F24 Technology
- Missile Technology
- Navy Technology
- Air Force Technology
- SMCA Execution

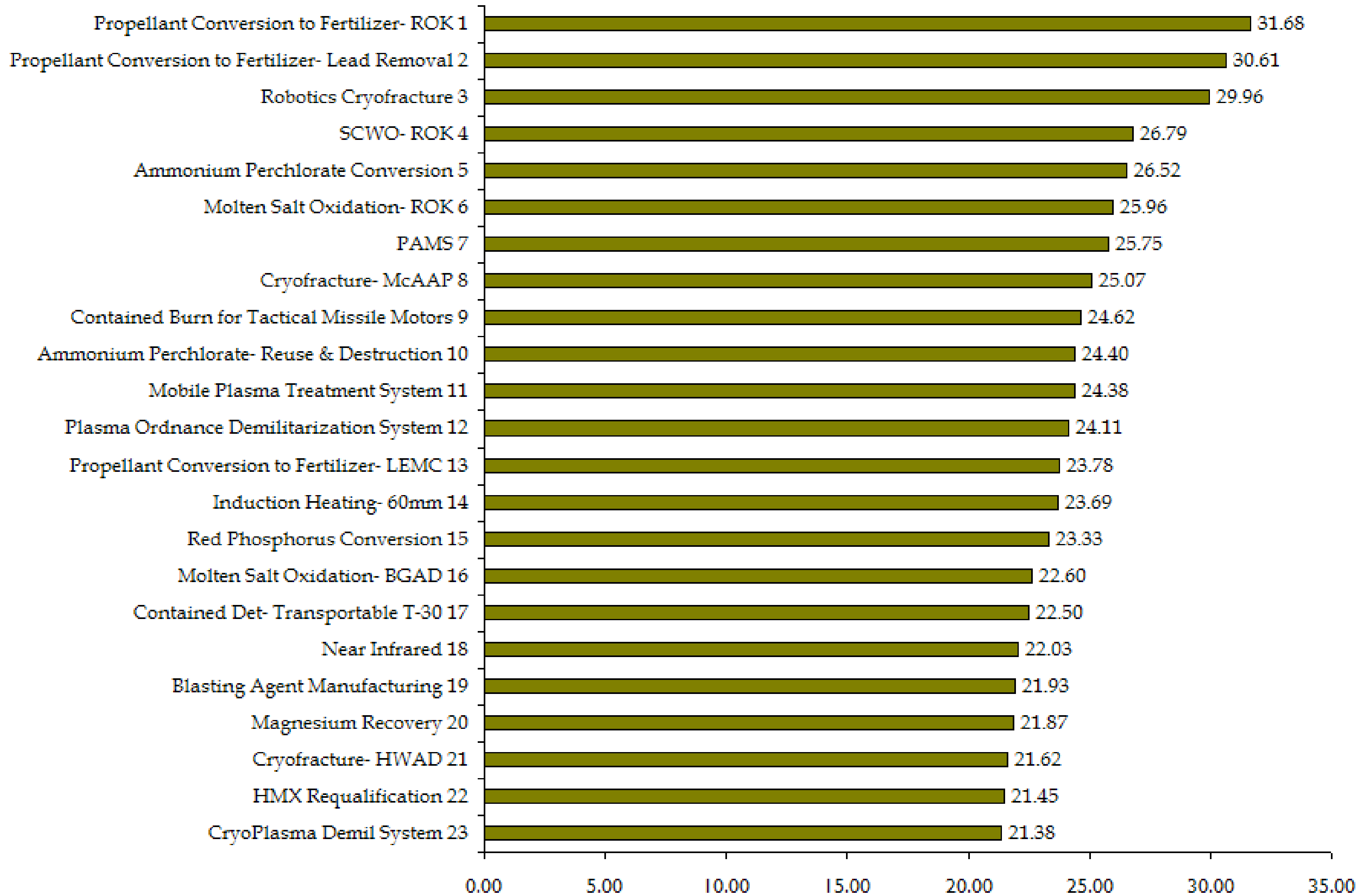
DRD IPT FY 07 Technology List

Technology Project	Contract Agency/Prime Developer
Abrasive Waterjet Cutting	NSWC Crane/UMR
Ammonium Perchlorate Conversion	NSWC Crane/Gradient
Ammonium Perchlorate- Reuse & Destruction	AMRDEC/Amtec Corp.
Blasting Agent Mfg. (Slurry Explosive)	NSWC Crane/TPL
Contained Burn for Tactical Missile Motors	NSWC Crane/El Dorado
Contained Detonation – Moving Mass	NSWC Crane/Porter Systems Inc.
Contained Detonation – Transportable (T-10)	NSWC Crane/Demil International
Contained Detonation – Transportable (T-30)	NSWC Crane/Demil International
Cryofracture - HWAD	NSWC Crane/GA
Cryofracture – MCAAP	ARDEC/GA
Cryofracture-Plasma Demilitarization System (CPDS)	ARDEC/GA & MSE
Energetics Recovery & Requalification	NSWC Crane/ATK Thiokol
Explosive Recovery System	NSWC Crane
Flashless Powder	NSWC Crane/TPL
HMX Requalification	NSWC Crane/TPL
Hydrolysis- Acid (Thin Skinned Munitions)	Tyndall AFB/GA
Hydrolysis- Acid	Tyndall AFB/GA
Hydrolysis- Al Bodied Munitions	Tyndall AFB/GA
Hydrolysis- Pollution Abatement System	Tyndall AFB/GA
Hydrolysis- Thin-Skinned Munitions	Tyndall AFB/GA
Induction Heating- 60mm	NSWC Crane/El Dorado
Magnesium Recovery	ARDEC/TPL
Mobile Plasma Treatment System (MPTS)	ARDEC/MSE

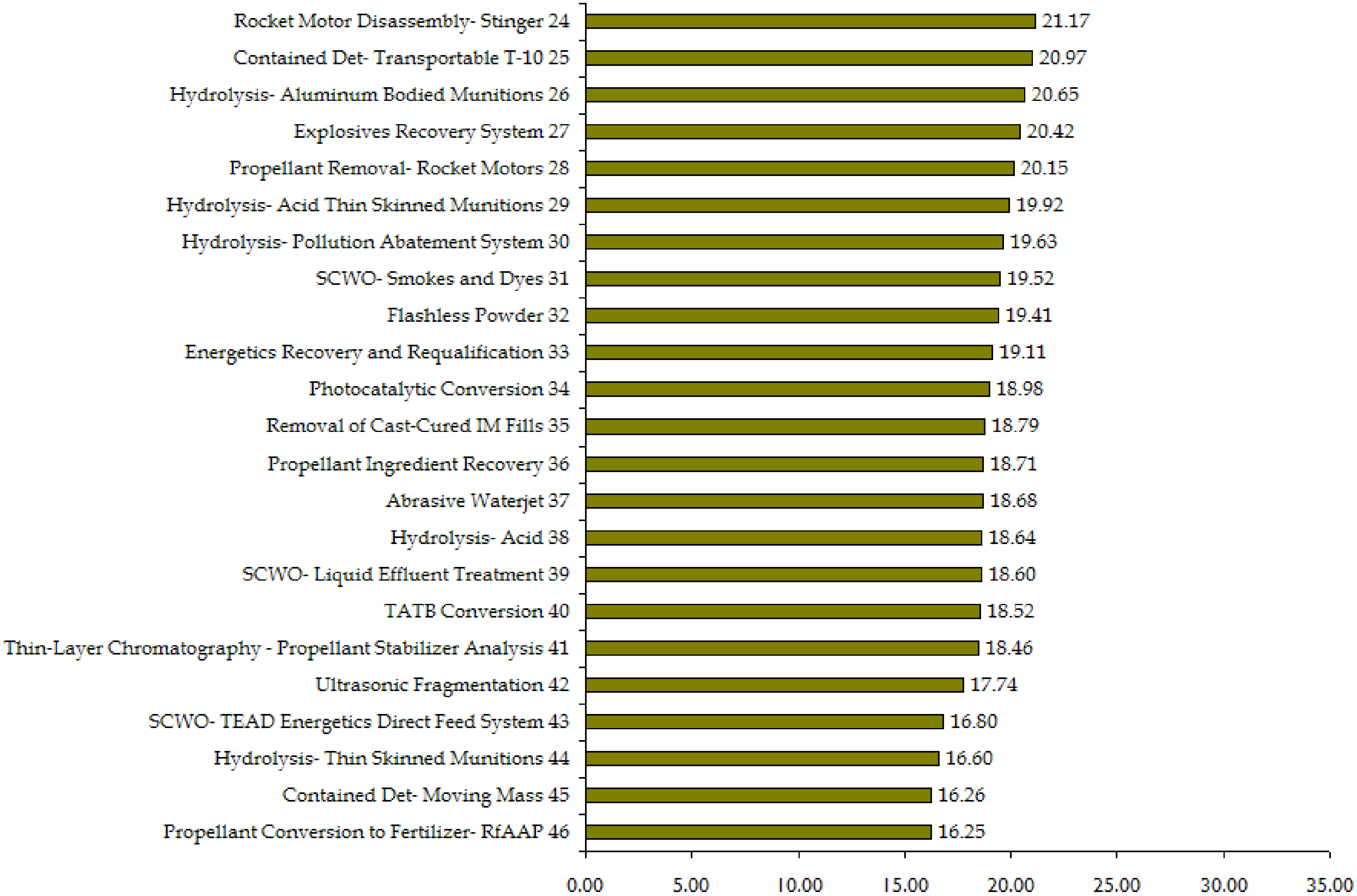
DRD IPT FY 07 Technology List

Technology Project	Contract Agency/Prime Developer
Molten Salt Oxidation – (BGAD)	NSWC Crane/MSE
Molten Salt Oxidation – (ROK)	NSWC Crane/MSE
Near Infrared (NIR) Technology	ARDEC/SAIC
Particle Aerosol Mass Spectrometer	DAC/Unknown
Photocatalytic Conversion	Hill AFB/OSU
Plasma Ordnance Demilitarization System (PODS)	ARDEC/MSE
Propellant Conversion to Fertilizer- Lead Removal	Huntsville/ARCTECH
Propellant Conversion to Fertilizer- LEMC	Huntsville/ARCTECH
Propellant Conversion to Fertilizer- RFAAP	Huntsville/ARCTECH
Propellant Conversion to Fertilizer- ROK	Huntsville/ARCTECH
Propellant Ingredient Recovery	ARDEC/Foster-Miller Corp
Propellant Removal- Rocket Motors	AMRDEC/Amtec Corp
Red Phosphorus Conversion	NSWC Crane/Unknown
Removal of Cast-Cured IM Fills	ARDEC/Battelle Memorial Labs
Robotics Cryofracture	DOE/SNL
Rocket Motor Disassembly- Stinger	AMRDEC/Amtec Corp
SCWO – Liquid Effluent Treatment	Tyndall AFB/GA
SCWO – ROK	Tyndall AFB/GA
SCWO – Smokes & Dyes	Tyndall AFB/GA
SCWO – TEAD Energetics Direct Feed System	Tyndall AFB/GA
TATB Conversion	NSWC Crane/Gradient
Thin-Layer Chromatography (TLC) – Propellants	DOE/LLNL
Ultrasonic Fragmentation	ARDEC/TPL

Initial Relative Effectiveness Ranking – pg 1



Initial Relative Effectiveness Ranking – pg 2



		Relative Effectiveness	% Difference fm Predecessor	% Difference fm First
1	Propellant Conversion to Fertilizer- ROK	31.68		
2	Propellant Conversion to Fertilizer- Lead Removal	30.61	-3.4%	-3.4%
3	Robotics Cryofracture	29.96	-2.1%	-5.4%
4	SCWO- ROK	26.79	-10.6%	-15.4%
5	Ammonium Perchlorate Conversion	26.52	-1.0%	-16.3%
6	Molten Salt Oxidation- ROK	25.96	-2.1%	-18.1%
7	PAMS	25.75	-0.8%	-18.7%
8	Cryofracture- McAAP	25.07	-2.6%	-20.9%
9	Contained Burn for Tactical Missile Motors	24.62	-1.8%	-22.3%
10	Ammonium Perchlorate- Reuse & Destruction	24.40	-0.9%	-23.0%
11	Mobile Plasma Treatment System	24.38	-0.1%	-23.0%
12	Plasma Ordnance Demilitarization System	24.11	-1.1%	-23.9%
13	Propellant Conversion to Fertilizer- LEMC	23.78	-1.4%	-24.9%
14	Induction Heating- 60mm	23.69	-0.4%	-25.2%
15	Red Phosphorus Conversion	23.33	-1.5%	-26.4%
16	Molten Salt Oxidation- BGAD	22.60	-3.1%	-28.7%
17	Contained Det- Transportable (T-30)	22.50	-0.4%	-29.0%
18	Near Infrared	22.03	-2.1%	-30.5%
19	Blasting Agent Manufacturing	21.93	-0.5%	-30.8%
20	Magnesium Recovery	21.87	-0.3%	-31.0%
21	Cryofracture- HWAD	21.62	-1.1%	-31.8%
22	HMX Requalification	21.45	-0.8%	-32.3%
23	CryoPlasma Demil System	21.38	-0.3%	-32.5%
24	Rocket Motor Disassembly- Stinger	21.17	-1.0%	-33.2%
25	Contained Det- Transportable (T-10)	20.97	-0.9%	-33.8%
26	Hydrolysis- Aluminum Bodied Munitions	20.65	-1.5%	-34.8%
27	Explosives Recovery System	20.42	-1.1%	-35.5%
28	Propellant Removal- Rocket Motors	20.15	-1.3%	-36.4%
29	Hydrolysis- Acid (Thin Skinned Munitions)	19.92	-1.1%	-37.1%
30	Hydrolysis- Pollution Abatement System	19.63	-1.5%	-38.0%
31	SCWO- Smokes and Dyes	19.52	-0.6%	-38.4%
32	Flashless Powder	19.41	-0.6%	-38.7%

		Relative Effectiveness	% Difference fm Predecessor	% Difference fm First
33	Energetics Recovery and Requalification	19.11	-1.5%	-39.7%
34	Photocatalytic Conversion	18.98	-0.7%	-40.1%
35	Removal of Cast-Cured IM Fills	18.79	-1.0%	-40.7%
36	Propellant Ingredient Recovery	18.71	-0.4%	-40.9%
37	Abrasive Waterjet	18.68	-0.2%	-41.0%
38	Hydrolysis- Acid	18.64	-0.2%	-41.2%
39	SCWO- Liquid Effluent Treatment	18.60	-0.2%	-41.3%
40	TATB Conversion	18.52	-0.4%	-41.5%
41	Thin-Layer Chromatography - Propellant Stabilizer Analysis	18.46	-0.3%	-41.7%
42	Ultrasonic Fragmentation	17.74	-3.9%	-44.0%
43	SCWO- TEAD Energetics Direct Feed System	16.80	-5.3%	-47.0%
44	Hydrolysis- Thin Skinned Munitions	16.60	-1.2%	-47.6%
45	Contained Det- Moving Mass	16.26	-2.0%	-48.7%
46	Propellant Conversion to Fertilizer- RfAAP	16.25	-0.1%	-48.7%

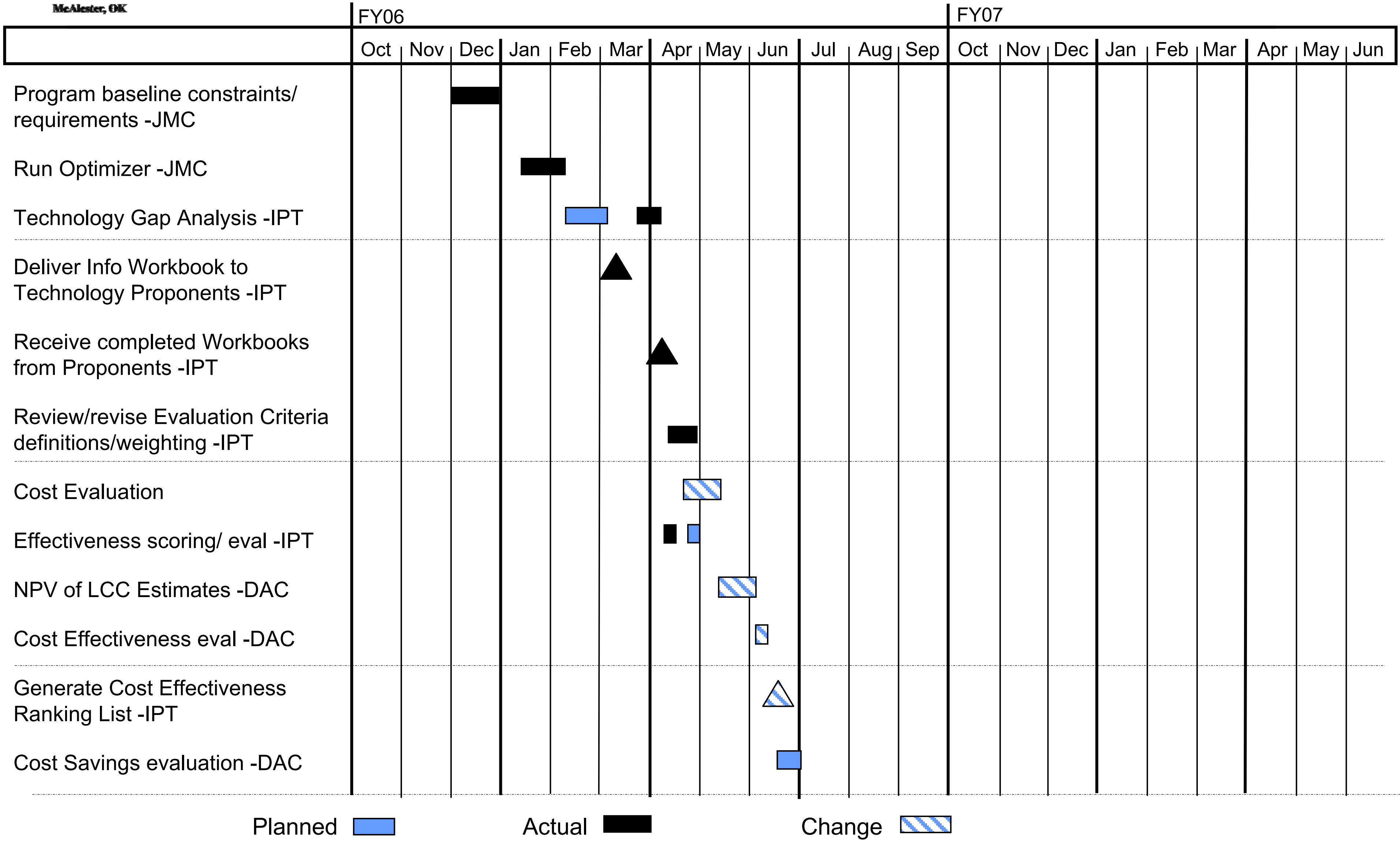
Evaluation Results

- Effectiveness measures how well projects perform relative to established criteria, independent of cost
- Cost-Effectiveness measures the cost of the project's effectiveness:
  - ✓ Cost-Effectiveness = (Net Present Cost of R&D and Facilitization) / Effectiveness
  - ✓ Units are cost per unit effectiveness
  - ✓ Cost-Effectiveness indicates how much "bang" for the "buck"
  - ✓ Because Cost-Effectiveness is a cost, smaller is better

R&D Technology Master Plan

- Document a systems engineering approach to translate demil needs into requirements that result in a set of prioritized technology projects.
- Master Plan documents the process :
  - ✓ AHP criteria and evaluation process
  - ✓ Relative operational and cost effectiveness calculations
  - ✓ Project management
  - ✓ Cost savings methodology and metrics
- Proprietary Supplement contains :
  - ✓ Project information workbooks
  - ✓ Relative operational and cost effectiveness measures
  - ✓ Quantitative assessment tool
  - ✓ Cost savings analysis
  - ✓ Budget request

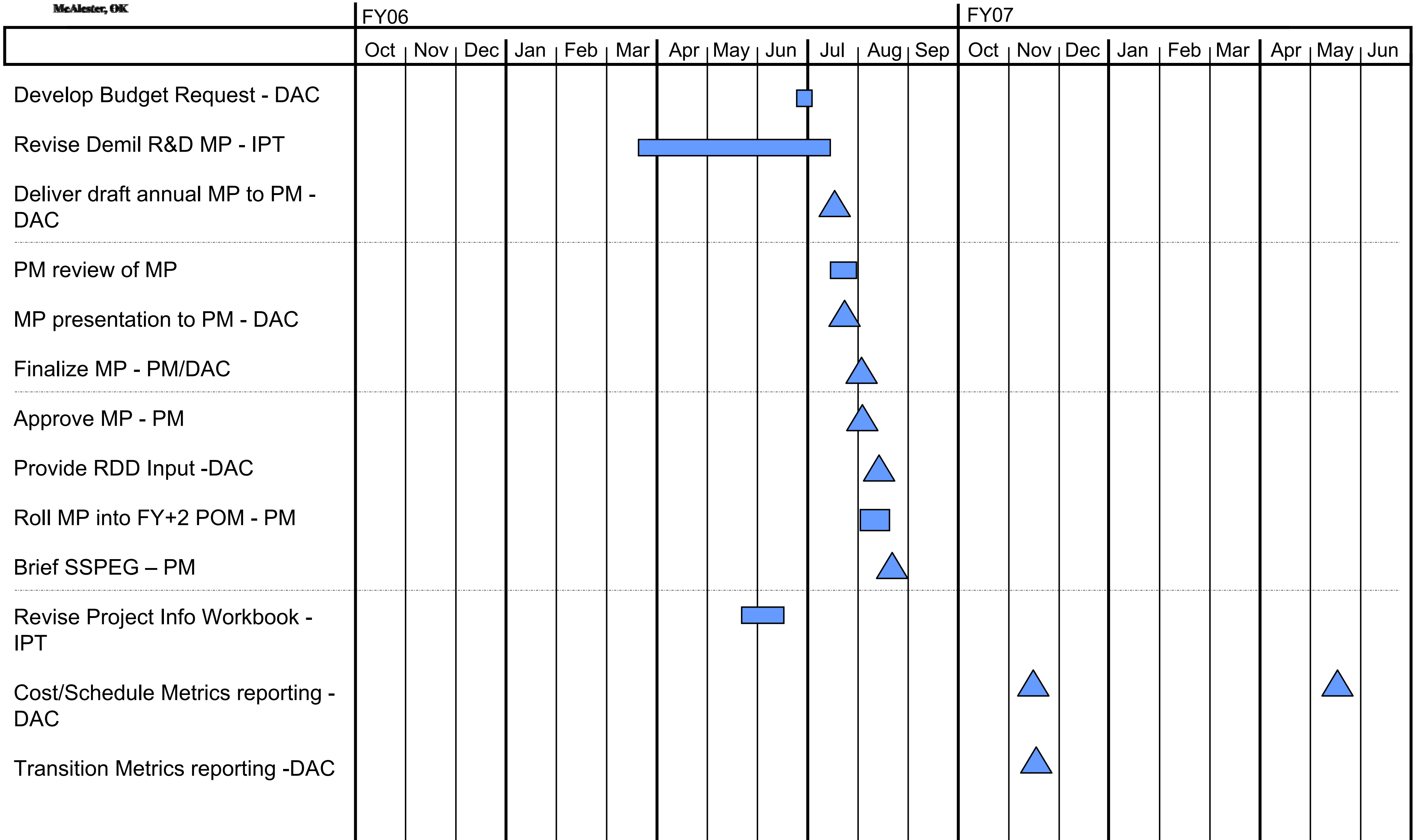
DRD Project Prioritization Schedule FY06



U.S. Army Defense Ammunition Center
McAlester, OK

DRD Project Prioritization Schedule FY06 (Cont'd)

PRODUCT MANAGER DEMILITARIZATION



R&D Metrics

- Standard Definitions (Phases)
  - ✓ Lab/Bench Scale
  - ✓ Subscale/Pilot Phase
  - ✓ Prototype Phase
- Goal: Establish Improved Metrics
- Core Members Agreed to:
  - ✓ Quarterly Cost and Schedule Reporting
  - ✓ Cost = Execution Year + Next Year
  - ✓ Schedule = Entire Project
  - ✓ Begins with New FY 06 SOWs
- Semiannual R&D Program Reviews (PRs)

DRD IPT Summary

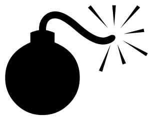
DONE

- Requirements Linked to Prioritization Process
- Revised Technology Project Information Workbook
- Completed Relative Effectiveness Evaluation for 46 FY07 Demil R&D Projects
- Developed Standard Terminology for SOWs
- Agreed to Quarterly Project Cost, Schedule and Performance Reporting

TO DO

- Complete Cost Effectiveness and Cost Savings Evaluations
- Provide Evaluation Feedback to Project Leads
- Provide Master Plan to PM Demil in July to Justify Demil R&D Technology Funding Requirements

Thank You,
Any Questions?



14th ANNUAL GLOBAL DEMILITARIZATION SYMPOSIUM

AMMUNITION PECULIAR EQUIPMENT (APE)

Joint Munitions Command

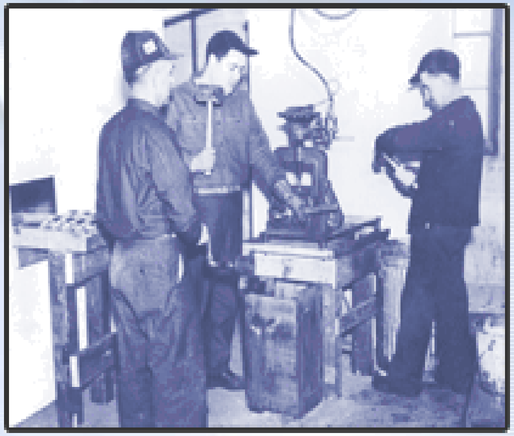
APE Enterprise Overview

Mr. Terry Hackett
SFSJM-LID
APE Program Manager
2 May 2006

APE Enterprise Update Outline

- History and Mission
- Goals and Organization
- Current Thrusts
- Program Support and Equipment
- Funding Levels and Budget
- Summary

The APE Story

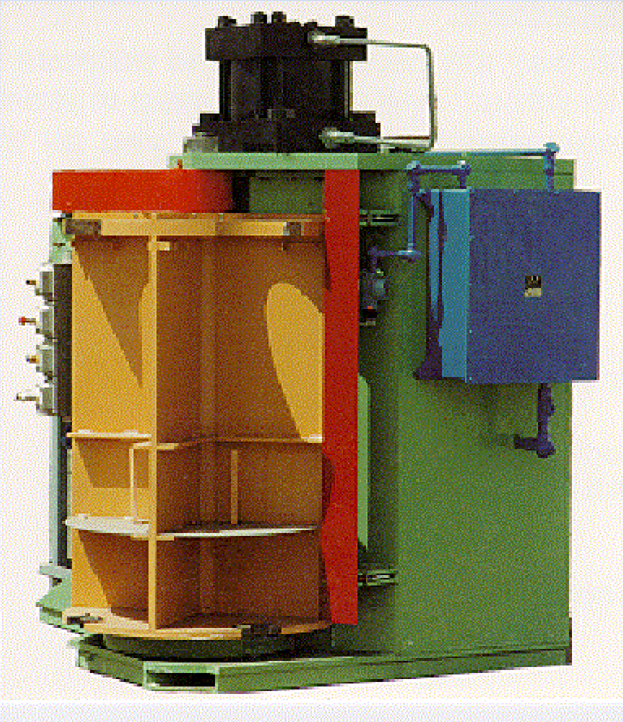


Established in 1955 with the mission of developing Ammunition Peculiar Equipment (APE) in support of maintenance, renovation, repair, and demilitarization of returned munitions.

APE Enterprise Mission

- Equipment and/or systems designed to perform specific operations on munitions
  - Demilitarization
  - Maintenance
  - Surveillance
  - Renovation
  - Packaging and Preservation
- Provides a central source of equipment
  - Avoids duplication
  - Configuration management
  - Review, test and approval process assures safe ammunition operations

APE 2197 Deprime Machine



Authority: AR 700-20; Web Site: http://www.apd.army.mil/pdffiles/r700_20.pdf

APE Enterprise Mission Goal

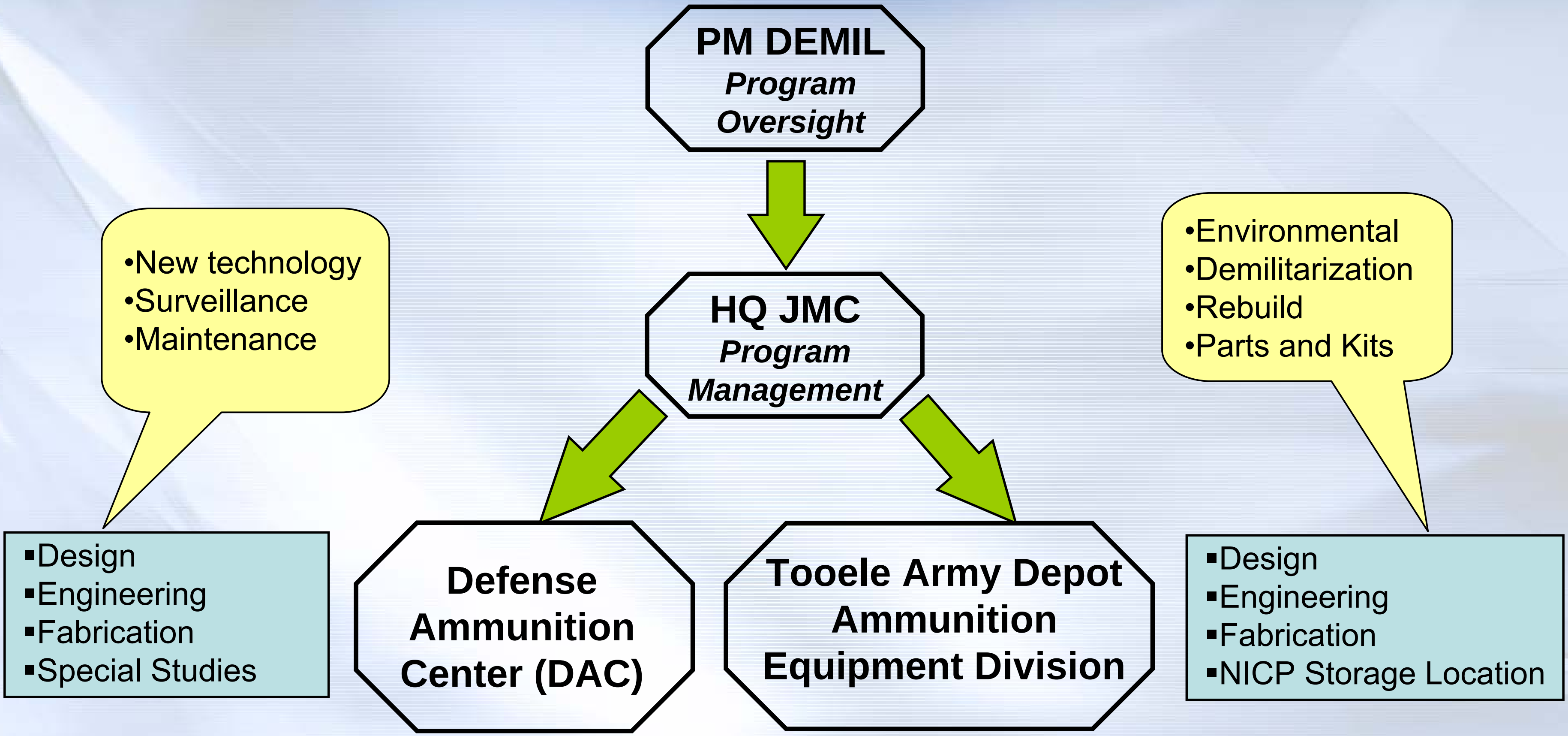
- Provide quality, productive equipment to meet customer requirements
  - Equipment is available for customers worldwide

- Provide customers with technical support, clear and accurate documentation, and workable solutions to problems
  - Fielding teams from the APE enterprise will provide on-site visits and scheduled familiarization training for customers

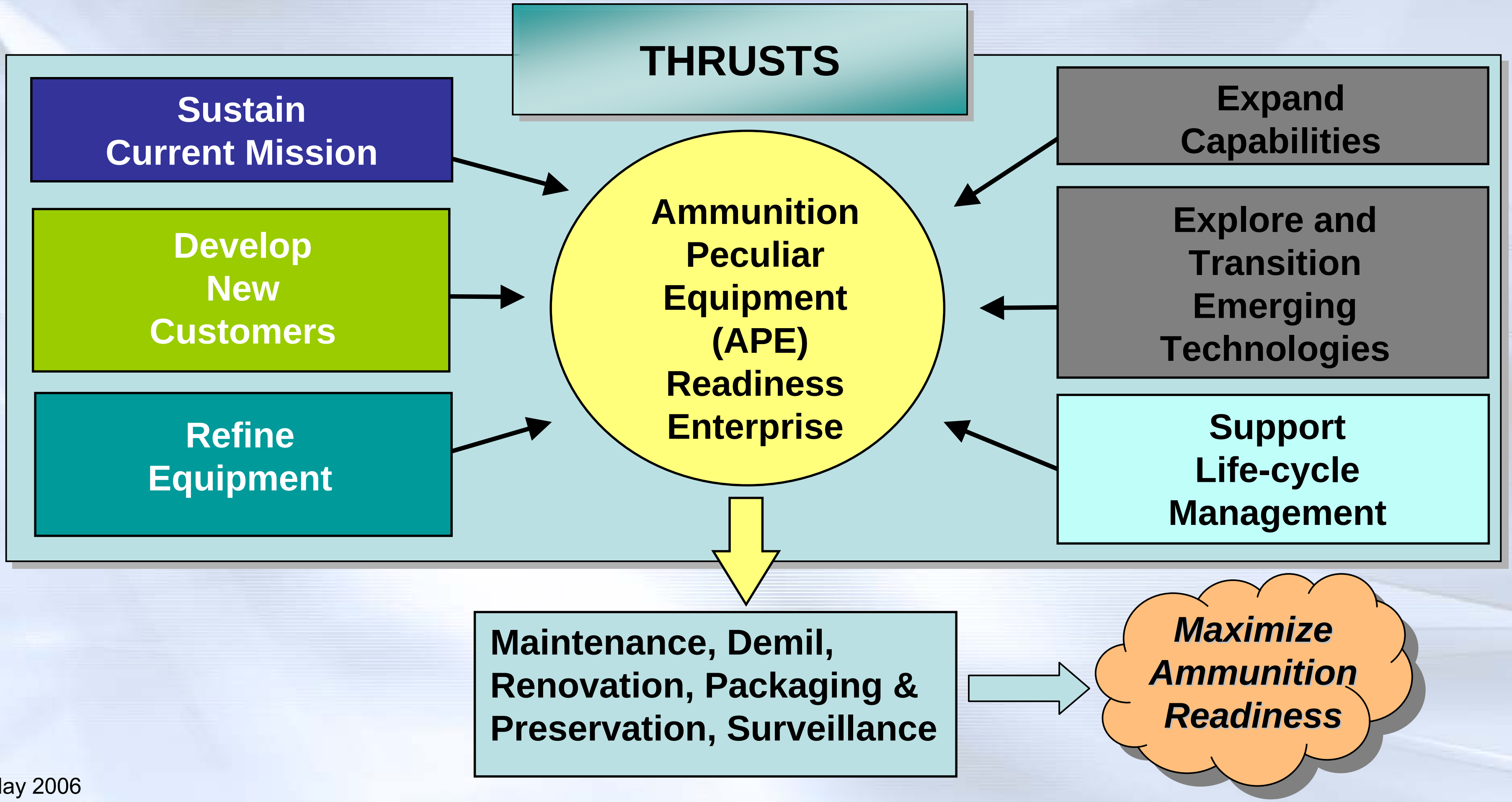
- Prepare for and satisfy future requirements by developing equipment, hiring and retaining a professional, well-trained staff, and identifying long-range funding to support program requirements

Customers: Depots and Plants, Munitions Centers, Ammunition Supply Points and other services/customers (DOD Agencies, FMS, contractors, and retail users)

APE Enterprise Organization



Ammunition Peculiar Equipment (APE)

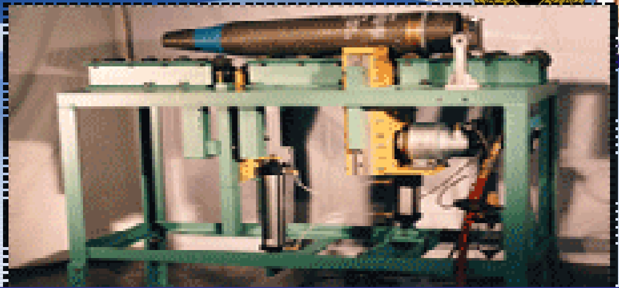


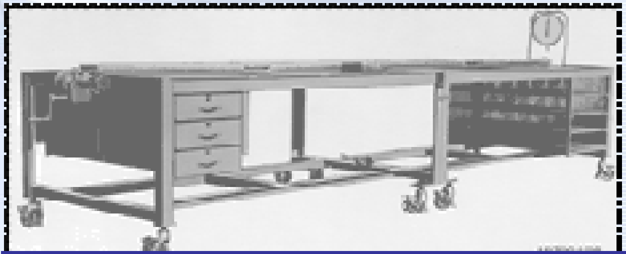
Worldwide Munitions Program Support

Enterprise APE


WP Conversion Plant


Pull Apart


Projectile Rolling Table


Surveillance Work Table


Vise


Linker-Delinker


Automated Tactical Ammunition Classification System (ATACS)


Safety Certification System


Shoe Tester

Proven and New Technology for DEFAC

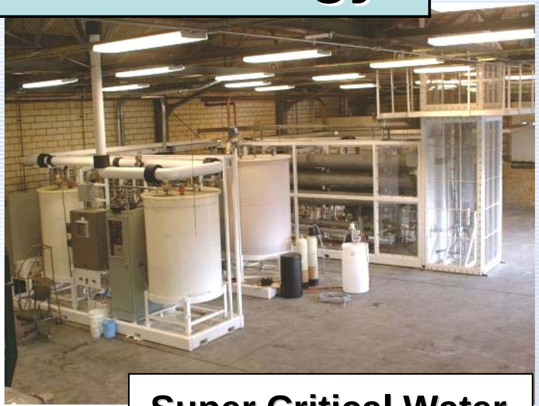
Proven Systems

Flashing Furnace

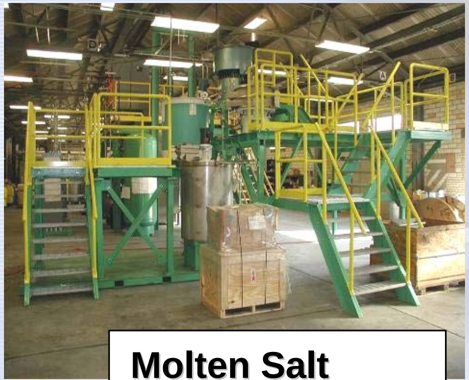
Autoclave Meltout

New Technology

Propellant Conversion to Fertilizer



Super Critical Water Oxidation (SCWO)



Molten Salt Oxidation (MSO)

Korea DEFAC Layout – Hwang-Gan

Autoclave/Flashing Furnace Site

APE 1401 Autoclave with SCWO, MSO & Pink Water Treatment System

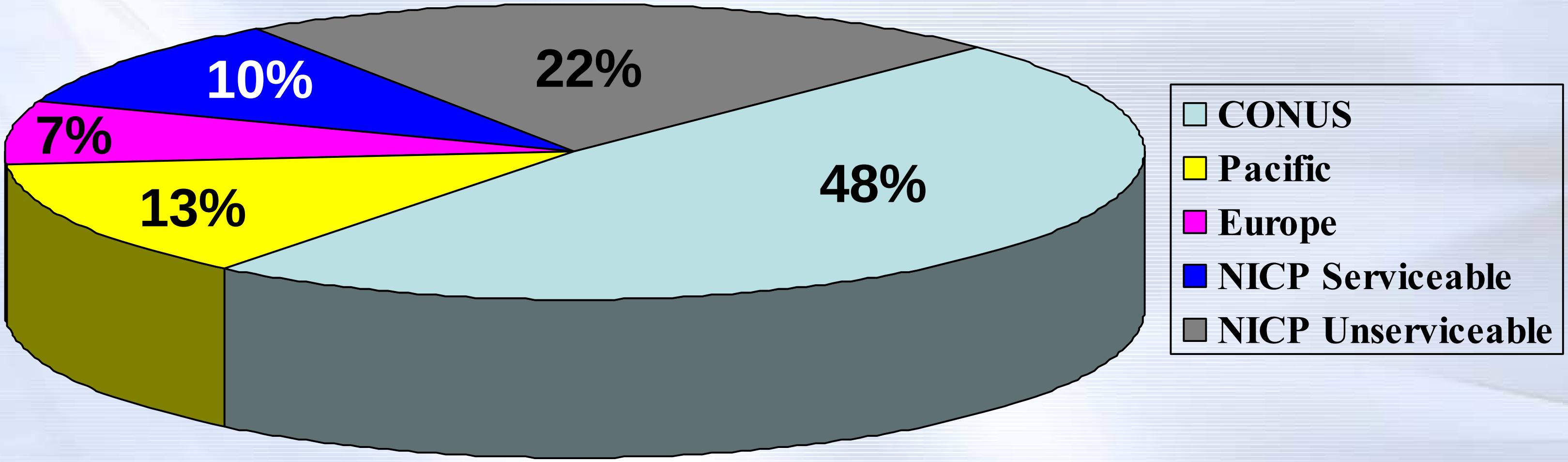
APE 2048 Flashing Furnace

APE Distribution

Inventory

8,500+ total APE items

$ 110 Million Value



Decision Hierarchy using Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS)

ATTRIBUTE (weight)

Operational (.20)	Safety & Health (.18)	Environmental (.18)	Urgency of Need (.17)	Economic (.17)	Public Interest (.10)

FACTORS (values)

Operational (.20)
- -Mobilization (5)
- -Readiness (4)
- -Disposal (3)
- -Surveillance (4)
- -Training (3)
- -New material fielding (1)
- -Maintenance float (3)

Safety & Health (.18)
- -Safety Issue (potential) (2)
- -Safety Issue (law) (3)
- -Imminent danger (personnel) (5)
- -Imminent danger (public) (5)
- -Imminent danger (property) (2)
- -No safety concern

Environmental (.18)
- -Compliance with law (3)
- -No environmental concerns

Urgency of Need (.17)
- -Current Requirement (2)
- -Future Requirement (1)

Economic (.17)
- -Cost avoidance (2)
- -Productivity
- -None (0)

Public Interest (.10)
- -Regional level (3)
- -Special groups (2)

METHODOLOGY

1. Analyze each project for the factors within each attribute
2 Total the values of applicable factors for each attribute
3. Insert attribute totals into appropriate positions on TOPSIS software
4. Run TOPSIS program to rank programs in relative closeness to ideal solution

APE Budget

PresBud 06-11 LOCK	FY06	FY07	FY08	FY09	FY10	FY11
Funded level	12,765	10,115	7,369	7,309	7,676	8,873

Dollar amounts in Thousands

APE Enterprise Summary

- APE aids the Warfighter by adding value to ammunition support operations worldwide.
- APE Program provides Equipment for the Single Manager for Conventional Ammunition community, providing solutions to some of the world's most taxing engineering problems involving explosives, propellants, chemical agents, and other hazardous materials.
- APE program provides munitions life-cycle support including technical assistance; consulting; training; equipment fabrication and maintenance; surveillance; and ammunition maintenance, renovation, and disposal.
- Recognized worldwide for producing quality products and quality service, on time and at competitive prices.

APE is Unique, Responsive, Reliable, Essential, Safe, Cost-Effective

Information Sources

Contacts:

Terry Hackett ***terry.hackett@us.army.mil***
JMC APE Program Manager
SFSJM-LID
Rock Island, IL 61299-6000
(309) 782-6881

Barry McCall ***barry.c.mccall@us.army.mil***
Chief, Maintenance Equipment Div, DAC
SJMAC-DEM
McAlester, OK 74501-9053
(918) 420-8198

Keith Siniscalchi ***keith.siniscalchi@us.army.mil***
Chief, Ammunition Equipment Div, TEAD
SJMTE-ALE-AE
Tooele, UT 84074
(435) 833-5042

- ***TM 43-0001-47***
Has pictures of APE items and general information on APE

INTERNET CATALOG
https://www4.osc.army.mil/apecat/

- ***APEOPS***

Access it thru the MIDAS Website

Or directly to

https://apeops.dac.army.mil/

Service DDAs – Enforcers of the Military Munitions Rule

Tony L. Livingston
HQ, Joint Munitions Command
E-mail: tony.l.livingston@us.army.mil
DSN: 793-0082   Comm: (309) 782-0082

ON THE LINE

JMC – On the Line

Briefing Outline

- ✓ DDAs Evolved From the Munitions Rule
- ✓ What Service DDAs Do!
- ✓ What Service DDAs Don’t Do!
- ✓ How DDAs Help the Demil Community
- ✓ These Are Your Service DDAs!
- ✓ Questions


03.21.2005


03.21.2005


03. 21. 2005


03.21.2005


03.21.2005


03.21.2005

DDAs Evolved from the Munitions Rule

- ✓ **Congress Directed Munitions Regulation**
  - ➢ **Federal Facility Compliance Act, Sep 92**
- ✓ **Munitions Rule (MR) Published 12 Feb 97**
- ✓ **MR Identifies When Munitions Become Waste**
  - ➢ **Abandoned**
  - ➢ **Removed for Disposal**
  - ➢ **Damaged or Deteriorated**
  - ➢ **Declared Waste by Authorized Military Official (AMO)**
- ✓ **DOD MR Implementation Policy Signed Jul 98**

  Chapter 6: DDAs are the only personnel authorized to declare unused munitions as waste military munitions (WMM).

What Service DDAs Do!

- Implement and comply with the DOD MRIP
  - Influence correct interpretation as needed
- Minimize the generation of waste Military Munitions
  - Evaluate for R3, training, testing, FMS, etc.
- Provide annual munitions forecasts to MACOM/Service/DoD DDA prior to bringing material into the B5A
- Provide timely munitions dispositions to customers
- Train, Train, Train!

What Service DDAs Don't Do!

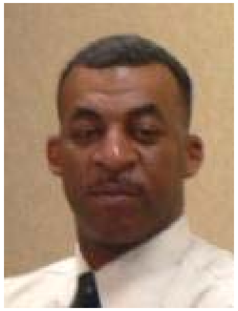
- ✓ Items that are not Military Munitions
- ✓ Munitions Emergency Response
- ✓ Items that are already WMM
  - ➢ Transported Off Range
  - ➢ Buried or Land Filled
  - ➢ Landing Off Range
- ✓ Items not in Physical Custody

How Service DDAs Help!

- ✓ **Munitions (waste) management focal point**
- ✓ **Flexibility in handling challenging situations**
- ✓ **Lead Change that affects implementation of MRIP**
  - ➢ **For example using Condition Code V**
- ✓ **Provide timely and accurate guidance to customers**
- ✓ **Use strategic planning to accrue the benefits of scale for the demil program**
  - ➢ **Web Based Disposition Location Lookup tool**

Army DDAs

Terry Hackett, HQ JMC, Rock Island, IL



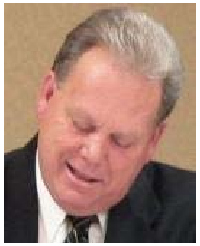
Tony King, HQ AMCOM, Red Stone Arsenal, AL

Steve Schoonmaker, ARDEC, Picatinny, NJ

Picture not Available

Bob Formica, ATEC, Aberdeen, MD

Navy DDAs



Jerry Lusk, NOLSC (Ammo), Mechanicsburg, PA

Don Gratzer, NSWC Crane, Crane, IN

Joe Schuppel, NSWC Indian Head, MD

Alan Lane, Patuxent River, MD

Picture not Available

David Williams, NSWC Indian Head, MD

Picture not Available

Richard Shoemaker, Patuxent River, MD

Air Force DDAs

James Bracey, Hill AFB, Ogden, UT

Bert Erickson, Hill AFB, Ogden, UT

DeWitt Edenfield, Robins AFB, GA

Marine Corps DDAs

Picture not Available

James Taylor, Systems Command, QUANTICO, VA

Picture not Available

Michael James, Systems Command, QUANTICO, VA

Service DDAs – Enforcers of the Military Munitions Rule

QUESTIONS?

JMC – On the Line

How Clean Is Safe?

U.S. Army Defense Ammunition Center

Tennessee Valley Authority

Authors: Ron Westmoreland, Rick Almond, and Dr. Bill Rogers

2006 Global Demilitarization Symposium & Exhibition
Indianapolis, Indiana May 2 – 5, 2006

How Clean Is Safe?

Outline of Briefing:

- Discussion of the Issue
- Background Study
- Scope of the Current Project

How Clean Is Safe?

DoD Instruction 4140.62

Management and Disposition of Material Potentially Presenting an Explosive Hazard (**MPPEH**)
December 3, 2004

<u>Effective management of MPPEH shall prevent "A transfer or release of MPPEH that will unintentionally present an explosive hazard to either a qualified receiver or the public."</u>

How Clean Is Safe?

DODI 4140.62 requires, after a 100 percent inspection and an independent 100 percent re-inspection, that the explosives safety status of material to be transferred within or released from DoD be documented as:

- **Safe** – Documented as not presenting an explosives hazard, and consequently safe for unrestricted transfer or release. Material that has been documented as safe is no longer considered MPPEH provided the chain of custody remains intact.
- **Hazardous** – The explosive hazards of the material are known or suspected and are documented, and consequently the MPPEH is transferable or releasable only to a qualified receiver.

How Clean Is Safe?

The question seems simple, but what does it mean?

- What is an explosive hazard – detonation, flashing, shock wave, gas evolution, or any reaction?
- What is accidental release – is there too much residual explosive, can it accidentally accumulate, can it be “harvested” for unintended use?

Safety is essential for all materials handled within DoD and transferred outside of DoD.

How Clean Is Safe?

Give us a threshold number!

There is no one number that fits all cases. The threshold is qualified by:

- What was the item possibly contaminated with?
- How has the item been demilitarized?
- What is the orientation of the item?
- Can the level of contamination be tested?
- Who is handling the item?
- Where is the item being sent?
- How will the item be transported?

How Clean Is Safe?

Just require that there is zero contamination!

What would that requirement cost?

Improvements in analytical methods have lowered the detection limits – what was once “zero” ppm can now be detected as measurable ppb.

Why spend demil funding to go below detection limits if an item can be “safely” handled and recycled with residual contamination?

How Clean Is Safe?

Give us a number that is better than 1X, 3X, and 5X!

The “X” designations are somewhat arbitrary.

However, “X” designations sometimes convey a needed description, and may be used in regulatory documents for a project.

This project will strive to establish a more descriptive designation.

The final result may be the establishment of a procedure to identify the threshold level for a demil process.

How Clean Is Safe?

Background Activities

Demilitarized Scrap Certification Project

Funded by DAC and executed by TVA, this project quantified the amount of energetic material left on demilitarized munitions and munition-related items after demilitarization by a number of processes.

Completed in April 2001

How Clean Is Safe?

Demilitarized Scrap Certification Project Scope

- 7 Demil installations were visited.
- 13 Demil processes were evaluated.
- 37 Sets of demil items were sampled.

- Thermal and non-thermal treatment processes, as well as disassembly activities, were sampled.

- Samples were analyzed and statistically evaluated.

How Clean Is Safe?

Demilitarized Scrap Certification Project Samples

- Projectiles
- Bombs
- Rockets
- Cartridges
- Cartridges cases
- Fuzes
- Munitions Components
- Propellant drums
- Armor plating
- Range scrap
- OD scrap

How Clean Is Safe?

Thermal Demil Processes Sampled

Process	Item	Primary Filler
Flashing Furnace	Projectiles, 5-Inch, 38-Caliber	Comp A-3
Hot-Gas Decontamination	Bomb, 750-Pound	Tritonal
Deactivation Furnace	Fuze, PD, M557	Tetryl
	Booster from M557 Fuze	Tetryl
Contaminated Waste Processor (CWP)	Projectiles, 105mm	Comp B
	Projectiles, 105mm	TNT
	Projectiles, 8-Inch	TNT
White Phosphorus to Phosphoric Acid Conversion (WP-PAC)	Cartridge, 4.2-Inch, M32A1 and M328	White Phosphorus
	Rocket, 2.75-Inch	White Phosphorus
	Igniter, Bomb, AN-23A1	White Phosphorus
Open Detonation (OD)	Miscellaneous	Various
	Armor Tile, AM2	PETN and Nitrocellulose
	Cartridge, 60mm	Comp B
	Cartridges, 81mm and 4.2-Inch	Comp B
	Projectile, 155mm	Comp B
Open Burn (OB)	Powder Cans, Mark 7	Smokeless Powder
Static Burn, Silo	Nike Hercules Rocket Motor	Double Base Propellant

How Clean Is Safe?

105mm Projectiles – TNT or Comp B

How Clean Is Safe?

Non-Thermal Demil Processes Sampled

Process	Item	Primary Filler
Meltout	Projectile, 105mm	Comp B
	Projectile, 8-Inch	TNT
	Bomb, 750-Pound	Tritonal
Washout – High Pressure	Projectile, 5-Inch, 38-Caliber	Comp A-3
	Ogive from Binary Projectile, 155mm, M687	Comp B/Oxamide Mix
Washout – Hot Water	Projectile, 105mm	Comp B
	Projectile, 105mm	TNT
	Projectile, 8-Inch	TNT

How Clean Is Safe?

8-Inch Projectiles – TNT

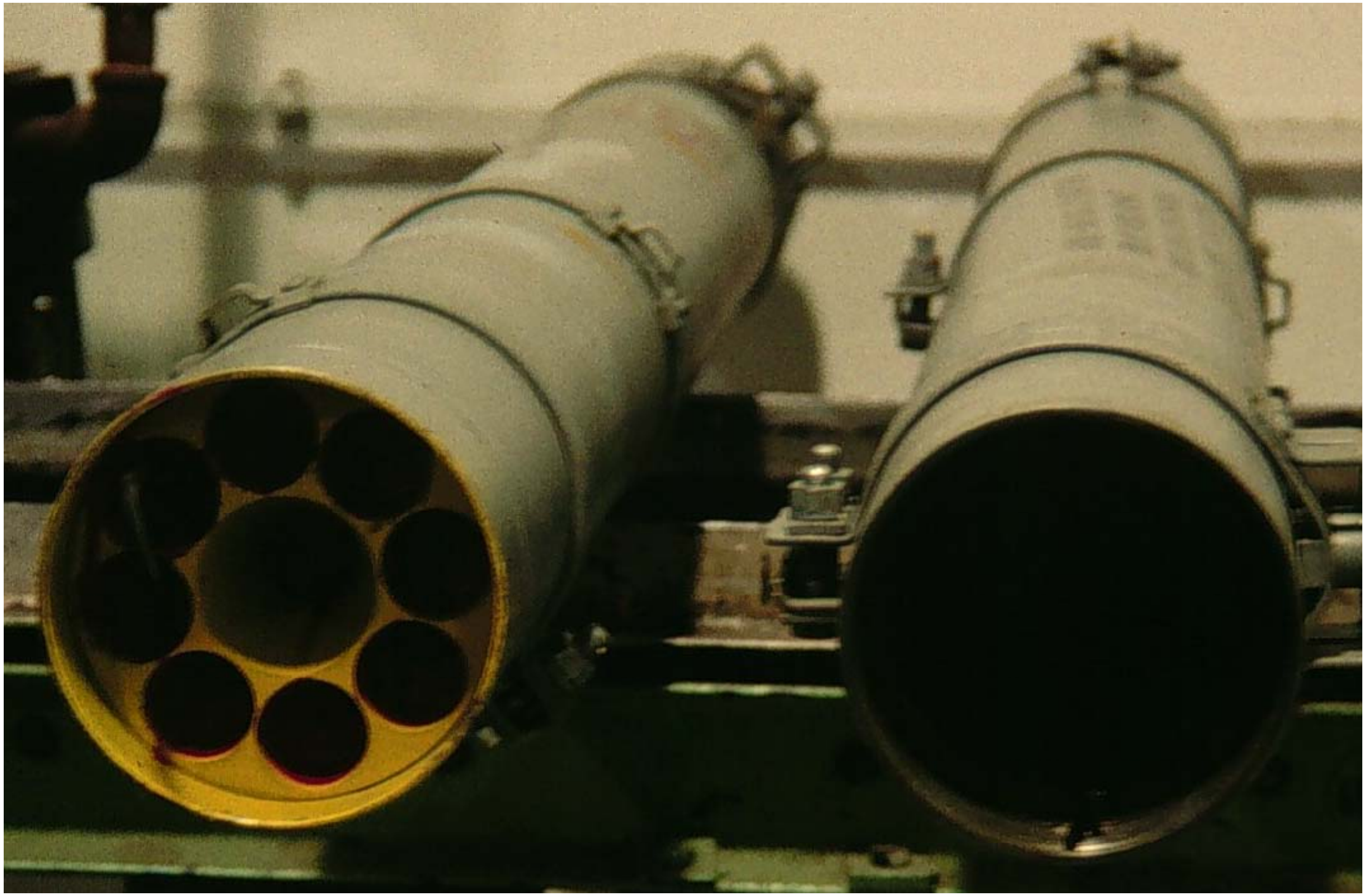
How Clean Is Safe?

Disassembled Items Sampled

Process	**Item**	**Primary Filler**
Disassembly of Munitions	Rocket Motor Tube, MK18 MOD 0	Double Base Propellant
	Cartridge Case, 105mm, M14B4	M1 Propellant, Bagged
	Cartridge Case, 105mm, M14B4	Smokeless Powder
	Cartridge Case, 105mm, MK9	Smokeless Powder
	Cartridge Case, 5-Inch, MK10 MOD 1	Smokeless Powder
	Fuze Well Liner, 105mm Site 1	Comp B
	Fuze Well Liner, 105mm Site 2	Comp B
	Fuze Well Liner, 105mm	TNT
	Fuze Well Liner, 8-Inch Site A	TNT
	Fuze Well Liner, 8-Inch Site B	TNT
Disposal of Propellants	Drum, Fiber	M1 Propellant, Loose
	Drum, Steel	M1 Propellant, Loose

How Clean Is Safe?

5-Inch Rocket Motors -- Nitroglycerine



How Clean Is Safe?

Project Objective

The purpose of this current project is to provide information that can be used to develop standards for determining how clean an item has to be in order to safely transfer or release it. The opposite view of the question may be more easily approached, "How contaminated can an item be before it becomes unsafe to transfer or release?"

How Clean Is Safe?

Initial Project Scope – Emphasis on Demil

- Identify the existing documentation relating safe handling of MPPEH to explosive cleanup levels.
- Identify the state of the art for rapid detection of explosive contamination.
- Determine the user requirements for clean up of munitions prior to turnover to recyclers.

How Clean Is Safe?

Initial Project Scope – Emphasis on Demil (cont.)

- Characterize the potential energy and gas release from the end product of various demil processes using the data from the Scrap Demil studies.
- Develop a procedure for determining if processed items are safe for release to a recycling process.
- Coordinate activities with the safety community.

How Clean Is Safe?

Potential Project Scope

- Test residual contamination from processes that were not included in the earlier sampling of demil processes.
- Test to determine safe threshold concentrations of various types of explosives based on propagation, Btu release, and gas formation.
- Perform tests using a pilot-scale smelter to determine impacts of Btu release, gas formation, item orientation, heat up characteristics and other pertinent data that may be needed.

How Clean Is Safe?

Future Project Scope

- Optimize demil processes to reduce costs based on safe residual concentration thresholds.
- Compare new rapid detection instrumental methods with human inspection.
- Expand the project findings to demolition of facilities and structures, and to transfer and release of range scrap.

How Clean Is Safe?

Special thanks to Jim Wheeler, Dottie Olsen, and the DAC team for their support.

Contact Information:

Dr. Bill Rogers – 256-386-3774, wjrogers@tva.gov
TVA
Reservation Road, CTR 1D
Muscle Shoals, AL 35661

AC/326 Sub-Group 5

NATO AC/326 (CNAD Ammunition Safety Group)
Sub-Group 5 (Logistic Storage & Disposal)
Activities

Presented by

Dr. Jerry M. Ward
Director, Policy Development Division
Department of Defense Explosives Safety Board Staff

Global Demilitarization Symposium & Exhibition - 2006

OUTLINE

- **AC/326 Partnership Group**
- **AC/326 Sub-Group 5**
- **Current Guidance**
- **Current Work Activities**
- **Future Work Activities**
- **Final Remarks**

AC/326 Partnership Group

Mission

On behalf of CNAD, to be responsible for ammunition life cycle safety in support of NATO priorities.

Scope of Work

All safety aspects of ammunition assigned for NATO operations, for their complete life cycle, in accordance with the objectives, priorities and requirements of the CNAD Management Plan.

► Disposal and Demilitarization ◄

AC/326 Partnership Group

Tasks

- **Develop standards and guidance and provide advice to ensure the design, qualification, and classification of safe and suitable ammunition.**
- **Develop standards and guidance and provide advice for safety acceptance of production ammunition.**
- **Develop standards and guidance and provide advice for the safe storage and processing of ammunition.**
- **Develop standards and guidance and provide advice for the safe transportation and handling of ammunition.**
- **Develop standards and guidance and provide advice to ensure operational safety of deployed ammunition.**
- **Develop standards and guidance and provide advice on compliance with national and international laws regarding disposal and demilitarization of ammunition.**
- **Act as the NATO focal point for operational ammunition safety issues arising during NATO operations.**

AC/326 Structure

AC/326
Partnership
Group

Terminology
Management
Team

MSIAC

SG 1
Energetic
Materials

SG 2
Initiation
Systems

SG 3
Munition
Systems

SG 4
Transport
Logistics

SG 5
Logistic
Storage &
Disposal

SG 6
Operational
Ammunition
Safety

AC/326 SG 5

MISSION

In support of the CASG, to be responsible for logistic storage & disposal of military ammunition matters.

SCOPE

The safe logistic storage, hazard classification, processing, and disposal of military ammunition in accordance with the objectives and tasking of the CASG Management Plan.

AC/326 SG 5

TASKS

- Develop standards and guidance on quantity-distance criteria to ensure an acceptable level of safety of military ammunition during logistic storage and during processing (that is receiving, inspection, identification, acceptance, inventorying, quality assurance, maintenance, assembly, disassembly, packing, unpacking) and disposal operations.
- Develop improved hazard classification standards and guidance for military ammunition harmonized with CASG qualification and safety standards.
- Develop standards and guidance and provide advice on disposal principles for military ammunition, including compliance with national and international laws regarding logistic disposal and demilitarization of military ammunition.
- Develop standards and guidance on design environment criteria for explosives areas.
- Undertake other studies and tasks as assigned by AC/326 Main Group.

AC/326 SG 5 Products

- **AASTP-1 – Manual of NATO Safety Principles for the Storage of Military Ammunition and Explosives**
  - **Part I – Depot Storage**
  - **Part II – Operations in Explosives Areas (includes Disposal and demilitarization)**
  - **Part III – Underground Storage**
  - **Part IV – Field Storage**

- **AASTP-3 – Manual of NATO Safety Principles for the Hazard Classification of Military Ammunition and Explosives**

Current Guidance
Demilitarization & Disposal

AASTP-1, Part II, Chapter 6, Section 6

- **This section contains advice pertaining to the destruction (by open burning/open detonation) of ammunition and explosives which has deteriorated or which has been declared surplus or obsolete. These recommendations establish measures and procedures for minimizing the risk in destroying unwanted ammunition and explosives. All destruction operations must be carried out in accordance with rules and regulations established by the competent National Authority.**

- **This section does not deal with matters pertaining to Explosive Ordnance Disposal (EOD) emergency actions.**

Current AC/326 SG POW Demilitarization & Disposal

- **14 Work Activities Total – DEU, GBR, NLD, NOR, & USA**

- **2 Work Activities on Demilitarization & Disposal – CAN**
  - **Develop improved destruction principles for military ammunition and explosives**
  - **Develop compendium of nationally approved demilitarization/disposal equipment**

*** 20 nations participate in SG 5 activities – 12 NATO, 6 PFP, Israel, & Australia**

USA INPUTS

- "Defense Ammunition Center Technology Directorate Demil Capabilities Matrix" dated 16 September 2005
- "U.S. Munitions Demilitarization" dated March 2006

MIDAS Family - Definitions

CD Munitions containing dyes as a primary disposal requirement. Also bulk dye materials.

CH Munitions containing hexachloroethane (HC) as the primary fill. Also bulk HC.

CP Includes a variety of ammunition types that contain white phosphorus (WP), or elasticized white phosphorus (PWP) as primary fillers. Items may also contain a high explosive, bursting charge, and/or propellant charge as well.

CR Usually referred to as riot control agents or munitions. Includes a variety of items that contain lacrimatory or irritating agents. Common fillers are tear gas, mace, or pepper gas. Common abbreviations for irritating agents are typically shown in the item nomenclature as CS, CN, or CR.

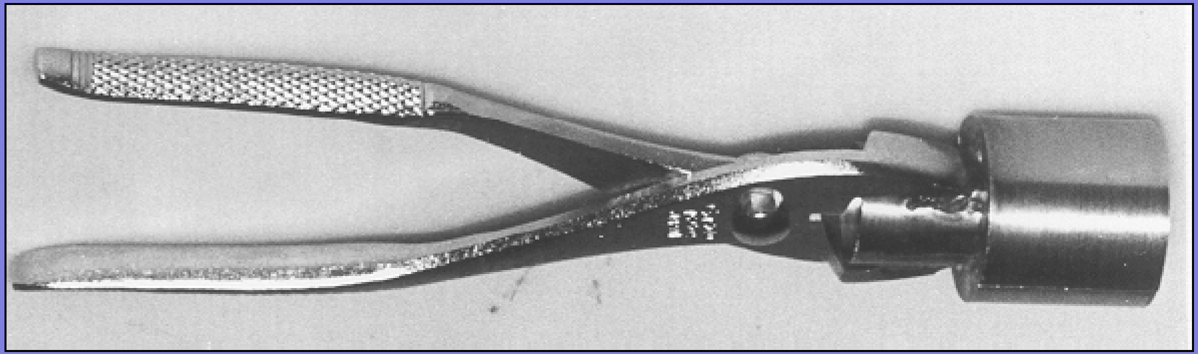
CS Munitions whose primary purpose is to produce smoke. This family does not include smoke-producing munitions that use white or red phosphorus, which are assigned to family CP, and those munitions containing HC, which are in family CH. This family also does not include munitions of a primarily pyrotechnic nature, such as those used for illumination or smoke and illumination, or signal kits, flares, and most simulators, which are included in family FP.

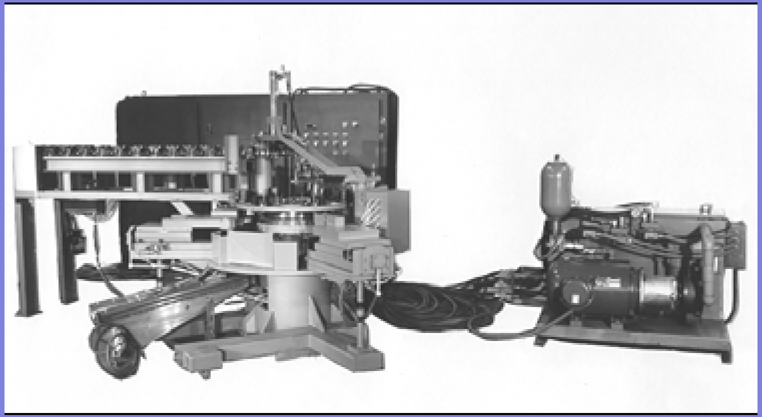
…

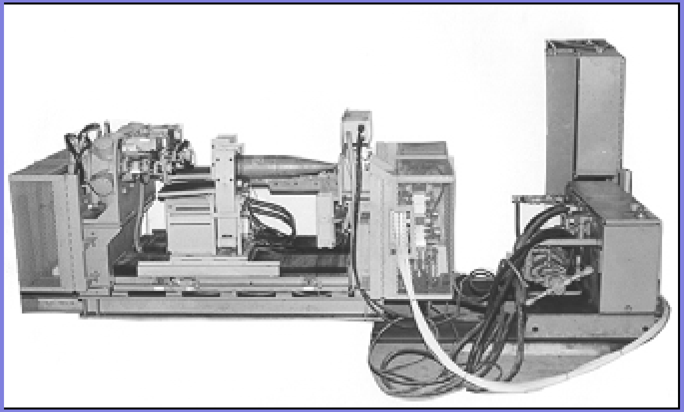
APE Linked to MIDAS Families

- **1001 - Vertical Pull Apart Machine (VPA) - HC, PD**
- **1001M1 - VERTICAL PULL APART MACHINE (VPA) - CD, CP, CR, CS, DU, FP, HC, HD, HI, HP, I, PC, PD, SC**
- **1002M1 - DEFUZING MACHINE, TWO SPINDLE - CD, CH, CP, CS, FP, HA, HB, HC, HD, I, PC, PD**
- **1003M1 - REMOVER, LID PNEUMATIC - CP, CR, CS, DU, FP, HC, HD, HI, N, PC, PD**
- **1010M2 - ASSEMBLY AND CRIMP MACHINE - CP, CS, DU, FP, HC, HD, HP, PC, PD**
- **1011M5 - BACKOUT DEPRIMING MACHINE - CP, FP, HC, HD, PC, PD**
- **1021M4 - PRIMER INSERTING MACHINE - CD, CP, CR, CS, DU, FP, HC, HD, HI, HP, HR, I, PC, PD, SC**
- **1042M3 - DEBANDING MACHINE, 57MM THROUGH 155MM - CD, CP, CR, CS, DU, FP, HC, HD, HI, HP, I, PC, PD**
- **…**

DISASSEMBLY TECHNOLOGIES







DISASSEMBLY TECHNOLOGIES

- **APE 2212 - M36 Burster Removal Tool**
- **APE 2214 - 30mm Depleted Uranium Projectile Breakdown Equipment**
- **APE 7040 - Medium Caliber Defuze-Deplug Machine**
- **APE 1002M3 APE 1 106M2 Two Spindle Defuzing Prime and Deprime Machine Machine**
- **APE 1001 M2 APE 1402-Large Vertical Pull Apart Munitions Saw Machine**

Technology. Disassembly technologies consists of a variety of Ammunition Peculiar Equipment (APE) and special tools specifically designed for removal/recovery of ammunition components.

Description. APE used in disassembly operations range from very simple tools designed to perform a single step to very complex systems. APE is designed, tested and safety approved to meet specific munitions requirements prior to use.

Applicability. This technology applies to all MIDAS families and is often used in conjunction with other technologies.

CONTROLLED INCINERATION

CONTROLLED INCINERATION

- APE 1236M2 Hazardous Waste Incinerator
- APE 1404 High Temperature Baghouse
- APE 1405 Afterburner
- Deactivation Retort Uncovered/Deactivation Retort Covered

Technology. Controlled incineration provides an environmentally acceptable capability not suitable for other demilitarization methods and reclaims the metal scrap for sale. The APE system consists of a deactivation retort, afterburner, cyclone, ceramic baghouse, draft fan, control panel, gas sampling system, connecting ducting and automatic feed system.

Description. Small munitions and/or components are fed on conveyors into the deactivation retort where they bum or detonate. Metal residues continue through the retort where they are discharged and collected for salvage. Flue gases travel through the afterburner where remaining organics are destroyed. The gases continue through the ceramic baghouse where particulate ash and heavy metals are removed from the exhaust stream.

Applicability. This capability applies to MIDAS families: small arms ammunition, miscellaneous incinerable munitions and components, fuzes, high explosive components, primers and boosters. The technology can also be used to flash larger items that are contaminated with explosive residues.

Future SG 5 Work Activities Related to Demilitarization and Disposal

- **AC/326 Partnership Group approved (Nov 05) development of SG 5 work activities related to clean-up of property contaminated with munitions and explosives of concern (MEC) such as:**
  - **Siting disposal and cleanup operations and related storage**
  - **Requirements for storage of waste military munitions**
  - **MEC hazard classification and storage**
  - **Minimum separation distances for unintentional detonations**
  - **Guidance on explosive hazards presented by soils/other media containing primary/secondary explosives, propellants, and propellant ingredients**
  - **Intentional burning of buildings contaminated with explosives residues that present an explosive hazard**
  - **Protection of personnel and property from UXO and MPPEH *(logistics, not operational/tactical environments)***

Final Remarks

- **AC/326 SG 5**
- **(Limited) Current Guidance**
- **Current Work Activities**
- **Future Work Activities**

U.S. ARMY, PACIFIC
Deputy Chief of Staff, G-4

PACIFIC COMMAND

JOINT SERVICE MUNITIONS RESOURCE RECOVERY PROGRAM

BRIEFER: **My Name is Jim Hale and I am a Soldier**

U.S. ARMY, PACIFIC
Deputy Chief of Staff, G-4

OPEN DETONATION (OD)

OPEN BURNING (OB)

Resource, Recovery, Recycle (R3)

ENVIRONMENTAL CONCERNS

EXECUTIVE AGENT

PACOM JOINT MUNITIONS DEMILITARIZATION WORK GROUP

USPACOM
* CAPT. DEBRA BODENSTEDT

DRMS/DRMO/DLA
* MR. JON MITSUYASU (DRMS-HAWAII)
MR. EDWIN DOMDOMA (DRMS-PACIFIC)
MR. DENNIS BAXTER (DRMO-HAWAII)

PACFLT
* MR. PETER BUTLER
MR. MARK MENTIKOV (SEAL BEACH)
MR. DONALD R. GRATZER (CRANE)
MR. JAMES COSPER (COMPACFLT)N4

USARPAC
** MR. JIM HALE
* MR. MICHAEL WEINBERG

PACAF
MR. GREG OSBUN
* MSGT THOMAS KAMINSKE
MR. JAMES BRACEY (HILL AFB)

MARFORPAC
*MGYSGT DENMAN

* PRIME POC
** CHAIRMAN

CUSTOMERS/PARTICIPANTS

	ALASKA	HAWAII	GUAM	KOREA	JAPAN	THAILAND
AIR FORCE	X	X	X	X	X	X
PACAF						
MRRO (HILL)						
NAVY/MARINES		X	X	X	X	X
PACFLT						
MARFORPAC						
NSWC						
ARMY	X	X		X	X	X
USARPAC						
JMC						
USPACOM						
USPACOM J423		X				
USFJ					X	
USFK				X		

PURPOSE

- LOCATE, IDENTIFY, PROGRAM, AND DEMILITARIZE MUNITIONS CANDIDATES THROUGH RESOURCE RECOVERY PROCESSES.
- ACCOMPLISH MUNITIONS RESOURCE RECOVERY IN A MANNER THAT SATISFIES EXPLOSIVES SAFETY AND ENVIRONMENT REQUIREMENTS.
- MAXIMUM JOINT PARTICIPATION BY SISTER SERVICES.

TASKS

- ESTABLISH AND IDENTIFY POC FROM EACH PACOM COMPONENT (USARPAC LEADS) -- COMPLETED.
- IDENTIFY BY SERVICE, LOCATION, DODIC, CONDITION CODE, AND TONNAGE, MUNITIONS ASSETS IN PACOM REQUIRING DEMILITARIZATION/RESOURCE RECOVERY -- CONTINUOUS.
- IDENTIFY ORGANIC DEMIL CAPABILITIES WITHIN PACOM -- COMPLETED.
- IDENTIFY PROSPECTIVE CONTRACTORS WITH MUNITIONS RESOURCE RECOVERY CAPABILITIES WITHIN PACOM -- LIMITED SUCCESS.
- LOOK AT FEASIBILITY OF ESTABLISHING A JOINT MUNITIONS RESOURCE RECOVERY FACILITY WITHIN PACOM –IN PROGRESS– KOREA
- DETERMINE EQUIPMENT REQUIREMENT FOR A MODERN FACILITY FOR MUNITIONS RESOURCE RECOVERY VS OB/OD --COMPLETED.

STRATEGY

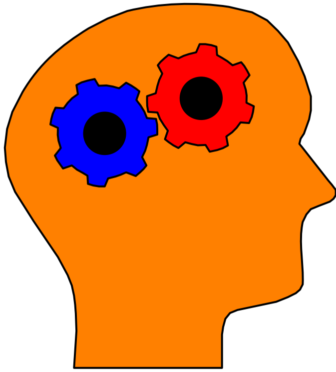
- IDENTIFY ASSETS (FAMILIES).
- IDENTIFY CAPABILITIES.

  LOCAL MUNITIONS RESOURCE RECOVERY/OPEN BURNING/OPEN DETONATION (OB/OD).

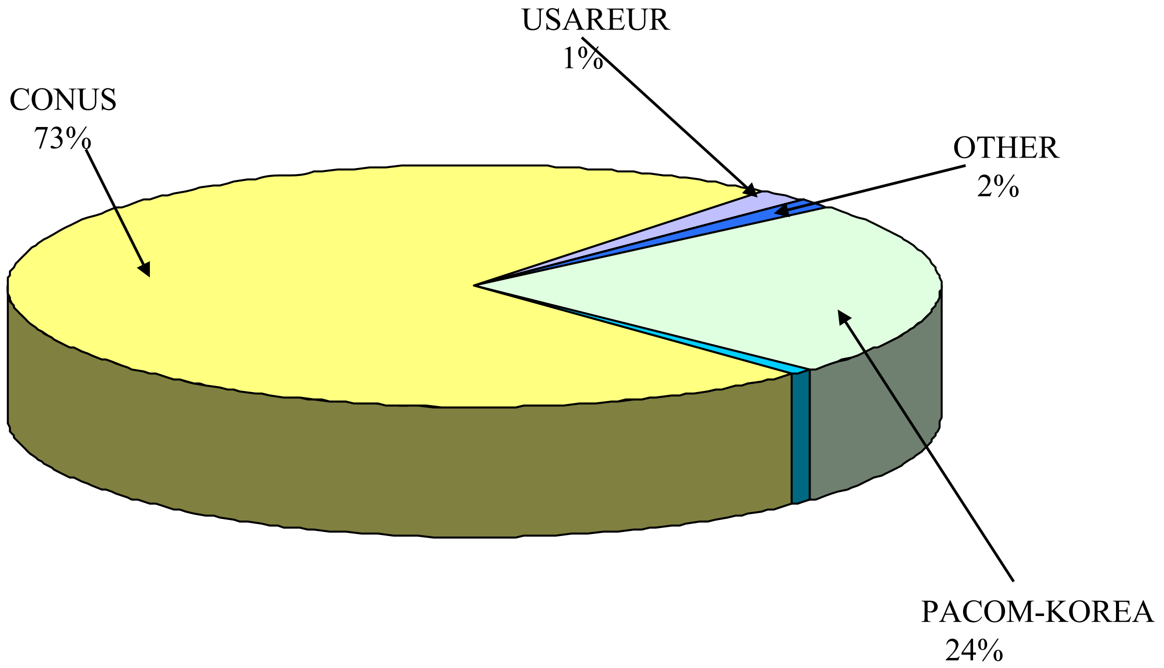
  REQUIRES RETROGRADE (CONUS/IN-THEATER).

  LOCAL CONTRACTING (JAPAN/KOREA).

  PRIVATE CONTRACTING (OUTSIDE SOURCES).



DISTRIBUTION OF ARMY STOCKPILE PERCENTAGE BY GEOGRAPHIC AREA



U.S OWNED MUNITIONS ONLY

Source: JMC WARS Report

As of JAN 06

Demilitarization Candidates
(Short Tons)

	ARMY	NAVY	USMC	AIR FORCE	TOTAL
ALASKA	23	0	0	0	23
HAWAII	0	0	0	0	0
GUAM	0	0	0	0	0
JAPAN	929	176	0	2	1107
KOREA	190914	0	0	0	190914
TOTAL	191866	176	0	2	192044

Technologies

Technologies Planned for Pacific Theater

- Melt out
- Incineration
- Boom Box (When Technology is Certified)
- Flashing Furnace
- Pink Water Treatment
- Super Critical Water Oxidation
- Molten Salt Process
- Propellant Conversion System
- Safety Certification Unit for Fired Brass

PACOM
DEACTIVATION FURNACES

GOAL: ESTABLISH TWO OPERATING JOINT USAGE FURNACES IN THEATER WITH CAPABILITY TO DISPOSE OF 1K STON OF SMALL ITEM MUNITIONS PER YEAR.

KOREA	1	KOREA (KOREA OWNED FURNACE)
JAPAN	1	83D ORD BN AREA (HONSHU)

PACOM
SAFETY CERTIFICATION UNITS FOR SMALL ARMS BRASS
(APE 1408)

GOAL: FOUR (4) UNITS IN THE PACIFIC THEATER- FIELDING DATE MAY 2003

	DISTRIBUTION	OPERATOR TRAINING
ALASKA	DECLINED	
HAWAII	1	NOV 03
JAPAN (OKINAWA)	1	OCT 03
KOREA	1	APR 06
TOTAL	3 UNITS	

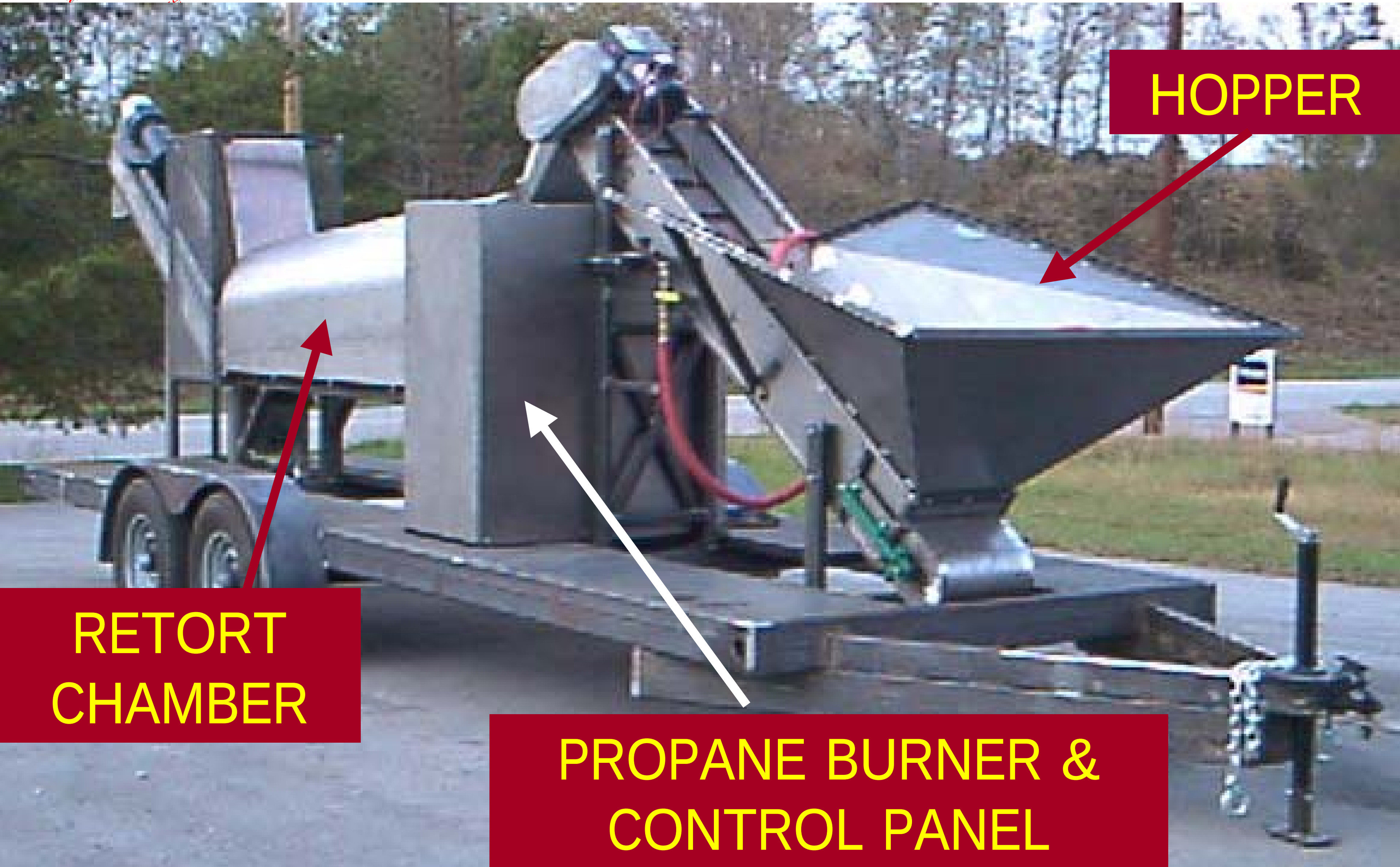
- APE 1408 DESIGNED TO THERMALLY CERTIFY PRE-INSPECTED 5.56MM THROUGH .50 CALIBER RANGE RESIDUE BRASS. BRASS IS INERT AND/OR FREE OF ENERGETICS AND CERTIFIABLE FOR RECYCLE.

- DRMS HAS A NEW REQUIREMENT FOR BRASS TO BE DEFORMED. DRMS IN PACOM HAS AGREED TO DELAY IMPLIMENTATION AT DRMO's UNTIL THE APE 1408 CAN BE MODIFIED TO ALSO DEFORM THE BRASS. TEAD IS CURRENTLY DEVELOPING THE REQUIRED MODIFICATION.

SAFETY CERTIFICATION UNIT

Hawaii(2,829 S/T as of Feb 06))

Japan (34 S/T as of Feb 06)



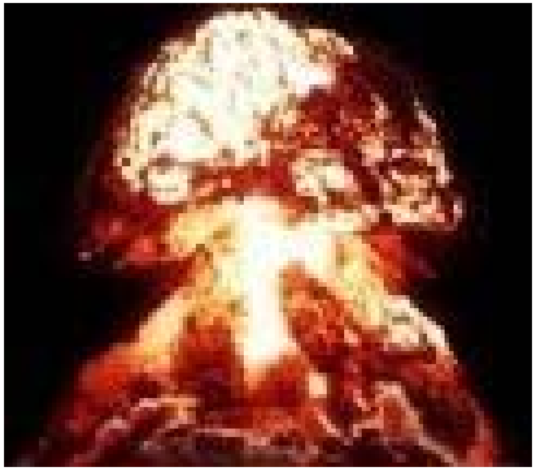
INITIATIVES

OPEN BURNING/OPEN DETONATION

ARE PROHIBITED DUE TO MORATORIUM

ALASKA/HAWAII/GUAM

- **EXPECT TO RETROGRADE. (EXCEPT FOR EMERGENCY DESTRUCTION)**



THAILAND INITIATIVES

- ASSETS GENERATED IN COUNTRY CAN BE DISPOSED OF LOCALLY.
- CANNOT SHIP ASSETS IN FOR PURPOSE OF DISPOSAL
- INFORMAL DISCUSSIONS: USARPAC AND JUSMAGTHAI

JAPAN INITIATIVES

- JOINT SERVICE MUNITIONS RESOURCE RECOVERY WORKING GROUP
- SURVEY OF OPEN BURNING/OPEN DETONATION SITES
- JAPANESE SELF-DEFENSE FORCE
- SURVEY OF INTERESTED LOCAL CONTRACTORS
- POSSIBLE COMMERCIAL CONTRACT
- DRMO/CONTRACTING OFFICE (YOKOTA)
- TRAINING/UNIT TURN-INS
- DEACTIVATION FURNACE FOR 83D ORD BN
- COORDINATION WITH DEFENSE FORCES FOR THE ESTABLISHMENT OF A JOINT USAGE OPEN BURNING/OPEN DETONATION SITE (ON GOING)

STATUS OF DEACTIVATION FURNACE - JAPAN

- ✓ FURNACE ON LINE: OCT 2000

KOREA INITIATIVES

- JOINT SERVICE MUNITIONS RESOURCE RECOVERY WORKING GROUP
- SURVEY OF OPEN BURNING/OPEN DETONATION SITES
- SINGLE AMMUNITION LOGISTICS SYSTEM-KOREA (SALS-K) MOA (CONTRACT)
- COMMERCIAL CONTRACT
- POSSIBLE TRANSFER TO ROKA (WRSA TRANSFER)
- DRMO ASSISTANCE (TO DISPOSE OF RESIDUE)
- LEGAL COUNSEL OPINION
- KOREAN PATRIOTS AND VETERANS ASSOCIATION (KPVA)
- MINISTRY OF NATIONAL DEFENSE (MND)
- TRAINING/UNIT TURN-INS
- ROKA INTEREST
- PURSUING MUNITIONS RECOURCE RECOVERY FACILITY FOR KOREA (OPERATED BY MND/GOVERNMENT CONTRACTOR)

CONTRACTS

KOREA

UNDER SINGLE AMMUNITION LOGISTICS-KOREA (SALS-K) REPUBLIC OF KOREA ARMY (ROKA) IS RESPONSIBLE FOR DISPOSAL OF U.S. ARMY OWNED MUNITIONS IN KOREA AND COMMERCIAL MUNITIONS RESOURCE RECOVERY IS OUTSIDE THE PURVIEW OF ROKA RESPONSIBILITY.

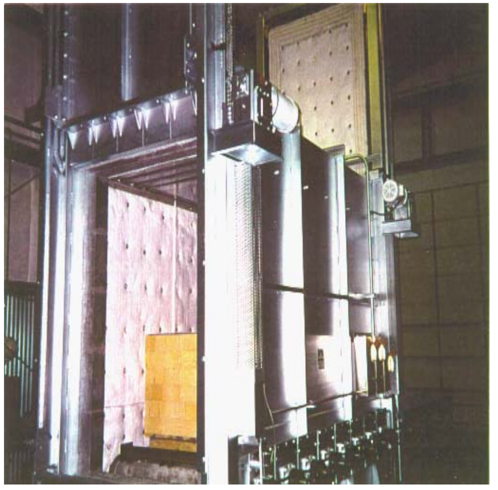
ROK MINISTRY OF NATIONAL DEFENSE (MND) LOGISTICS ADVISES THAT CURRENT LAWS HAVE NO PROVISIONS WHICH ALLOW COMMERCIAL DEMILITARIZATION OF DEFENSE MATERIEL.

THE FEASIBILITY OF PURSUING A CONTRACT IN KOREA IS A LONG RANGE OBJECTIVE WITH MANY LEGAL DETAILS TO BE WORKED OUT.

CURRENT FOCUS IS TO FIND WAYS TO INCREASE MND'S RESOURCE RECOVERY CAPABILITY.

R3 FACILITY – KOREA (DEFAC)

- JOINT US/ROK DEMILITARIZATION FACILITY IS THE PRODUCT OF A MOA SIGNED IN 1999 (US/ROK)
- FACILITY WILL BE SHARED BY ROK AND US
- ROK-MND SELECTED AN EXISTING MUNITIONS STORAGE AND PROCESSING SITE NEAR HWANG-GAN, KOREA FOR CONSTRUCTION
- NEW MOA SIGNED 4 SEP 2003
- GROUND BREAKING CEREMONY START CONSTRUCTION JUN 06
- TARGET DATE FOR OPERATIONS – MAR CY08



R3 FACILITY – KOREA (DEFAC)

- Provide the capability in Korea to dispose of unserviceable munitions in a timely and cost-effective manner.
- ROK Provides: Land, buildings, utilities, ammo storage and transportation
- US Provides: Equipment and installation, employee training, surveillance and production control
- Design capacity --- approx. 8,000 short tons annually

R3 FACILITY – KOREA (DEFAC)

- CAPABILITY OF DEFAC INCLUDES:
  - MELTOUT (20 KETTLES)
  - INCINERATION (1 ROKA OWNED FURNACE)
  - PROPELLANT CONVERSION TO FERTILIZER SYSTEM

R3 FACILITY – KOREA (DEFAC)

- FACTS
- ROK-MND RELEASED $23.58M TO ROK ARMY FOR CONSTRUCTION OF JOINT USE DEFAC AND PROCUREMENT ON AN INCINERATOR.
- PROVIDED $9.8M FOR LOCAL COMMUNITY WELFARE PACKAGE FUNDED THROUGH ROK ARMY.
- YONGDONG COUNTY OFFICE ISSUED CONSTRUCTION PERMIT FOR DEFAC SITE IN JUN 05.

PASOLS

- PACIFIC AREA SENIOR OFFICERS LOGISTICS SEMINAR.
  - PASOLS INITIATIVE NO. 27 : "ESTABLISH A DEMILITARIZATION FACILITY AVAILABLE FOR ALL COUNTRIES IN THE PACIFIC THEATER TO DISPOSE OF UNWANTED MUNITIONS."
- COUNTRIES WITH CANDIDATE ASSETS FOR DISPOSAL PROGRAMS.

  - oo JAPAN
  - oo CHINA
  - oo PHILIPPINES
  - oo BRUNEI
  - oo SINGAPORE
  - oo TAIWAN (NON PASOLS)

PASOLS

PASOLS INITIATIVE NO. 27
GOAL: DEVELOP PACIFIC REGIONAL DEMILITARIZATION FACILTIES.

STATUS: MEMBER NATIONS HAVE CONVENTIONAL WEAPONS AND MUNITIONS REACHING END OF SERVICE LIVES REQUIRING DISPOSITION. WORKING GROUP MEETINGS ARE NORMALLY HELD IN CONJUNCTION WITH WORLDWIDE DISPOSAL CONFERENCES. U.S. REPRESENTATIVES BRIEF CURRENT CAPABILITIES AND STATUS TO THE WORKING GROUP.

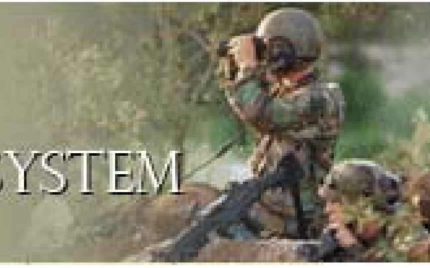
LOGISTICS STEERING GROUP (LSG) DECISIONS: ENCOURAGED INTERESTED MEMBERS TO CONSIDER PARTNERING WITH U.S. TO BUILD ADDITIONAL DEMILITARIZATION FACILITIES IN THE PACIFIC THEATER AND TO SEND DELEGATES TO THE GLOBAL DEMILITARIZATION SYMPOSIUMS & EXHIBITIONS.

BOTTOM LINE

- ALL SERVICES, AT ALL LEVELS IN PACOM, ARE WORKING TOGETHER, TO CREATE A ENVIRONMENTALLY SOUND AND FISCALLY RESPONSIBLE DEMILITARIZATION PROGRAM.

MIDAS

MUNITION ITEMS DISPOSITION ACTION SYSTEM



Global Demilitarization Symposium

02 May 2006

MIDAS Overview

Presented by Tyrone Nordquist

MIDAS

MUNITION ITEMS DISPOSITION ACTION SYSTEM

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Army News

- Army treating more PTSD
- Special Ops school moves from Jordan to Iraq
- Army women dominate Armed Forces Cross Country
- All-Army Sports registration moves to Internet
- Army 07 budget boosts FCS, 'irregular warfare'
- WWII 82d Airborne hero lands in Afghanistan
- Study shows troops back from Iraq get help for stress
- Insurgents captured after attack on Coalition
- Corps conducts Alaska earthquake exercise
- Army helps construct new DC school facility

MIDAS Features

The mission of MIDAS is to provide a central source of the most accurate information on the structure and composition data for conventional munitions.

MIDAS supports demilitarization (DEMIL) planning; resource reuse, recovery and recycling; DEMIL technology R&D applications; and environmental permitting and impact assessments.

MIDAS is an ongoing program managed by the U.S. Army Defense Ammunition

Defense Ammunition Center

MIDAS

MUNITION ITEMS DISPOSITION ACTION SYSTEM

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- MIDAS Products Info
- Existing Capabilites
- Characterization Searches ▸
- Unitloads
- Diagrams
- MIDAS Families
- Report Data Discrepancy
- Master Munition Items
- 2005 Symposium Video

ches

pe

ngsten

COMPS DODIC=a010

COMPS DODIC=c454

COMPOUND NOMEN=tungsten

Central Library

Category	# Items
Munitions	8024
Components	26398
Parts	92362
Part Materials	12283
Bulk Materials	5799
Compounds	3361
Diagrams	383
Unitloads	986

Advanced Search — Global search over all categories.

Global Search

Word Search — Global search by any word (including synonyms).

Powered by MIDAS v.0146

Last 6 Expands

- CTG 105MM HERA M927
- CTG 10GA SHOTGUN BLK M220
- DET CORD ASSY
- CTG IGN M752A1
- DISP & BOMB ACFT CBU 52B/B
- PROJ SUBASSY 5IN/38 AAC/HC MK52 MOD0

Announcements

- **Global Demil Symposium & Exhibition**
  The 2006 Global Demil Symposium & Exhibition will be held at The Westin in Indianapolis, IN from 1-5 May. Contact Nick Smith at (918) 420-8139 for further details.

Defense Ammunition Center

MIDAS

MUNITION ITEMS DISPOSITION ACTION SYSTEM

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- Related Systems Info
- APEOPS
- MACS Demo
- Tech Trees

L

B

MATERIAL NOMEN=tungsten

PARTS NOMEN=w

COMPS DODIC=a010

COMPS DODIC=c454

COMPOUND NOMEN=tungsten

Central Library

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MIDAS

MUNITION ITEMS DISPOSITION ACTION SYSTEM

Argonne National Lab
•Software Development

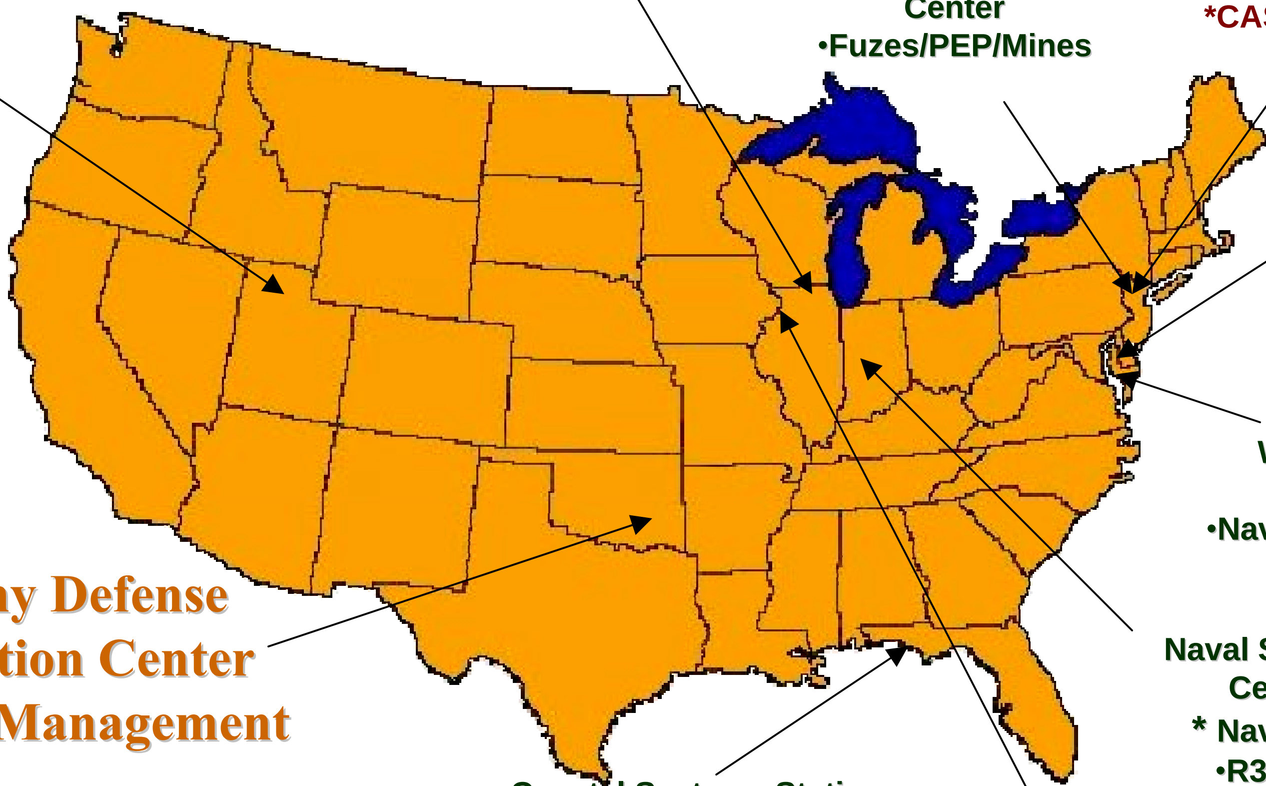
US Army Armament Research and Engineering Center
•Fuzes/PEP/Mines

Chemical Compliance System

*CAS Identification

Hill AFB
•AF CAD/PAD

Chemical Propulsion Information Agency
•RKT propellants



Naval Surface Warfare Center Indian Head
•Navy/Army CAD/PAD

US Army Defense Ammunition Center Program Management

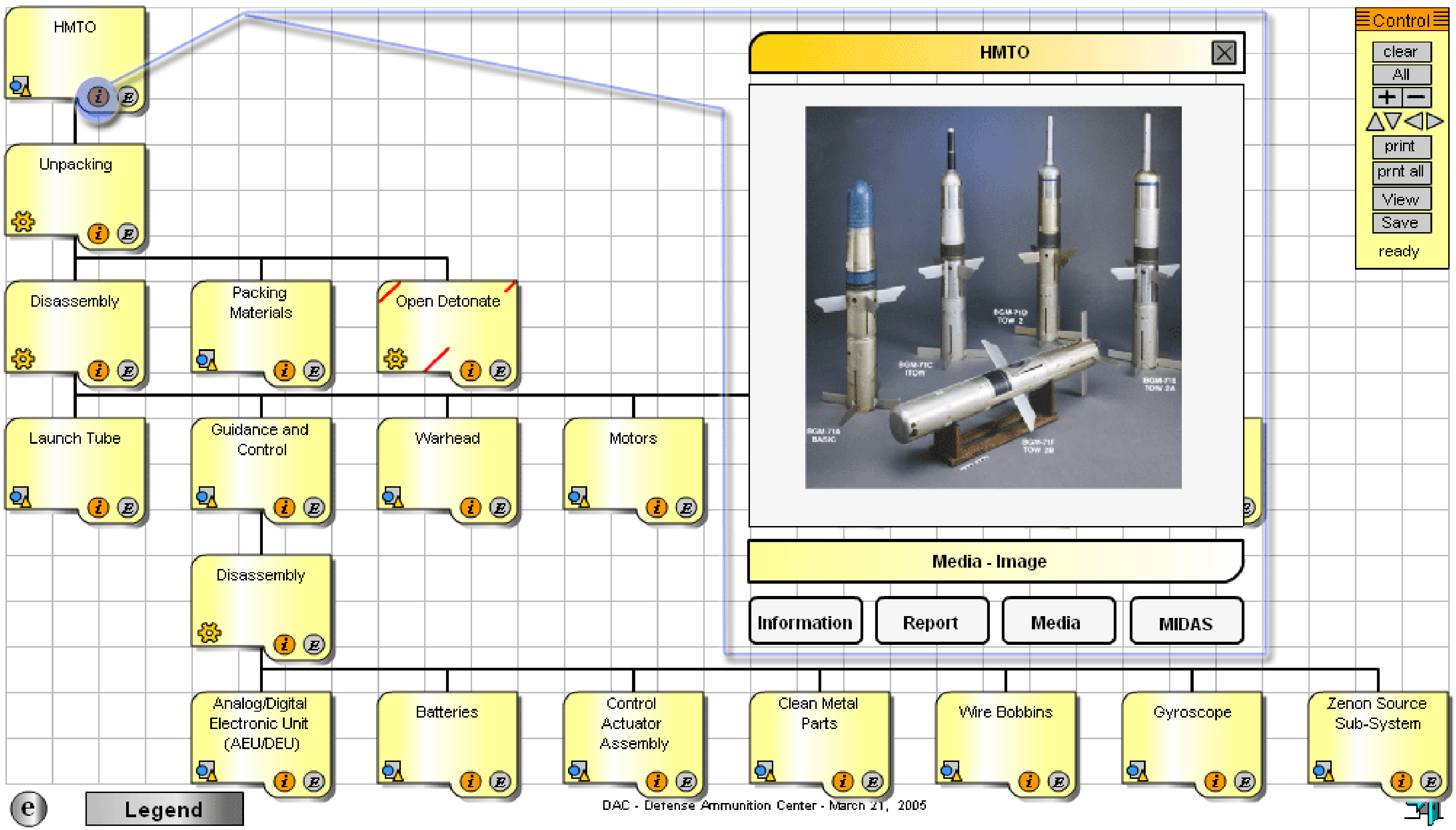
Naval Surface Warfare Center, Crane
* Navy Gun Ammo
•R3 Procedures

Coastal Systems Station Panama City
•Underwater Mines

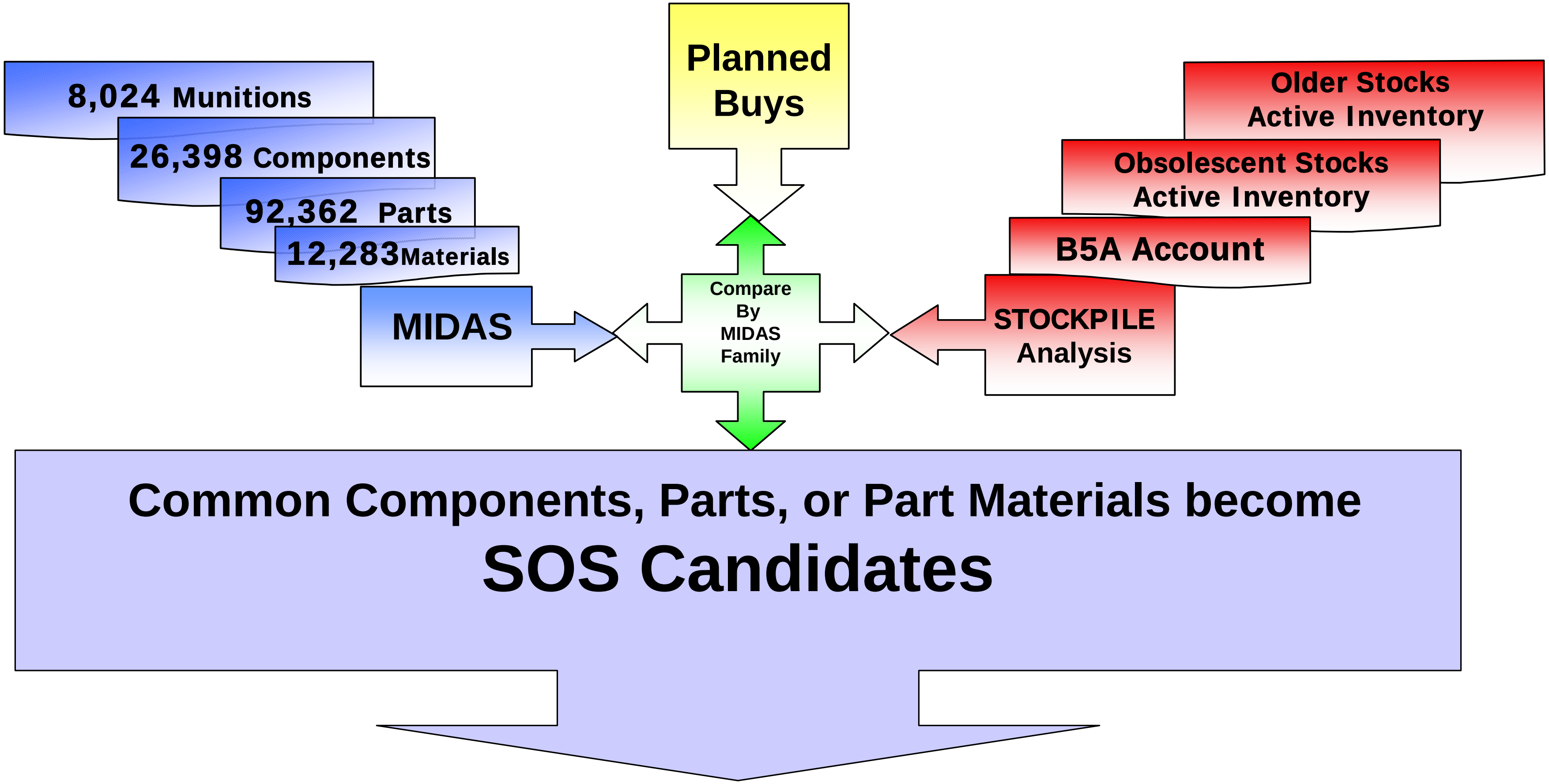
QuantiTech Davenport, IA
•Missiles

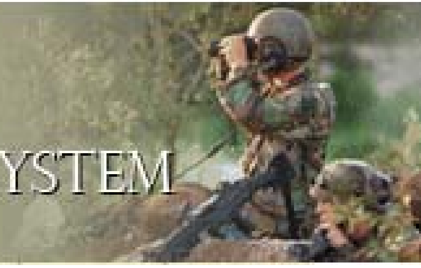
MIDAS
MUNITION ITEMS DISPOSITION ACTION SYSTEM

Technology Trees



Source of Supply





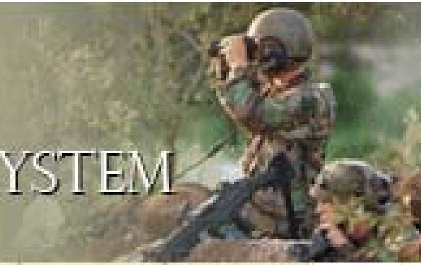
Firing Point/Impact Point Data

Analysis Of Remaining Effluent/Residue as a result of range operations

Approximately 2000 munitions complete

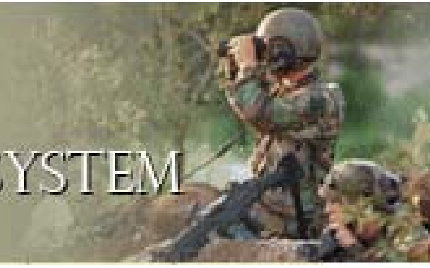
Supports Military Munitions Rule and Range Reclamation Efforts

- **Provides the following data:**
  - **Location (Firing Point/Impact Point)**
  - **Identifies munitions by constituents (both standard and alternates)**
  - **Identifies portions of munitions that can be collected for recycling or disposal.**



MIDAS Program Customers

- Demil – Commercial & Organic
- Maintenance / Renovation
- Safety / Health
- Training
- Testing
- Environmental
- Medical Community
- Acquisition
- Packaging
- DOD Studies
- Law Enforcement Agencies
- EOD
- Legal Community
- Foreign Countries
- UXO / Cleanup (FUDS)
- UN Demining
- Toxic Chemical Demilitarization Program



SUMMARY

- MIDAS is the source to identify source of supply candidates which saves acquisition costs and ultimately providing more funds for warfighter support.
- MIDAS characterizations provides constituent data for munitions instantly that supports R3 initiatives and environmental concerns.
- MIDAS helps the R&D community identify and close the demil technology gaps to more effectively demil assets, ultimately freeing up limited storage for warfighter stocks.

MACS Identification of Chemicals of Concern

14th Global Demil Symposium
May 1-5, 2006
Indianapolis, IN

George R. Thompson, Ph.D.
Chemical Compliance Systems, Inc.

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.

Figure 1. FY01 COCs Analysis Criteria

- Compared CY99 (12 Sites) & CY00 (13 Sites)
- 51 Munition Constituents Demiled >4,000 lbs./year (All Sites Combined)
- 18 TRI Reportable Chemicals/Compounds
- Regulatory Impact – 10 Lists
  - ☯ Carcinogens (x2)
  - ☯ Teratogens (x2)
  - ☯ Neurotoxins (x2)
  - ☯ EHS
  - ☯ HAPs
  - ☯ TRI
  - ☯ CAA
  - ☯ CWA
  - ☯ CERCLA
  - ☯ EPA's 275 Most Toxic
- Health Impact — Acute & Chronic — Composite Ratings
- Ecological Impact — Air/Water/Soil — Composite Ratings
- 19/51 Greater Concern
- Updated Analysis for CY02 & CY03 — No New COCs

Figure 2. Total Munitions Demilitarized, 1999–2005

CALENDAR YEAR	CHARACTERIZED NSNs	MUNITION WT. [a]	CHEMICAL WT. [a]	# SITES	COCs [b,c,d]	TRI
1999	506	64,331,977	60,508,324	12	44	15
2000	464	69,853,801	66,142,981	13	47	18
2001	632	39,169,105	37,818,778	13	—	—
2002	572	29,707,053	28,709,278	12	—	—
2003	526	52,130,628	48,858,695	11	42	19
2004	315	36,733,092	32,873,093	10	42	20
2005	289	26,018,476	25,049,293	8	34	18

[a] Lbs./year
[b] Total Weight for all demil sites combined >4000 lbs./year
[c] COCs for CY99 & CY00 combined = 51
[d] COCs for CY03, CY04 & CY05 combined = 47

Figure 3. Munition Constituent COCs, 2003–2005 —Quantities Processed

CAS #	CHEMICAL	QTY PROCESSED 2003	QTY PROCESSED 2004	QTY PROCESSED 2005
7439-89-6	IRON	**25,607,681**	15,853,952	11,066,911
118-96-7	TNT	**6,624,851**	3,696,266	2,544,068
9004-70-0	NITROCELLULOSE	**6,519,559**	6,184,592	3,326,702
7429-90-5	ALUMINUM	**2,350,007**	1,712,898	1,518,670
121-82-4	RDX	**1,856,227**	592,376	1,811,744
55-63-0	NITROGLYCERIN	**1,147,398**	771,222	364,636
7440-50-8	COPPER	**960,165**	530,761	756,656
556-88-7	NITROGUANIDINE	**729,506**	522,523	3,166
693-21-0	DIGLYCOL NITRATE	**560,171**	542,682	193,761
7440-61-1	URANIUM 238	**510,051**	710,661	460,887
7440-66-6	ZINC	**503,948**	107,688	180,920
7440-47-3	CHROMIUM	**136,684**	80,487	100,405
7439-92-1	LEAD	**49,423**	50,694	38,949
84-66-2	DIETHYLPHTHALATE	**13,492**	3,657	6
3811-04-9	POTASSIUM CHLORATE	**8,435**	70	86
57-11-4	STEARIC ACID	**6,489**	3,466	7,030
7440-22-4	SILVER	**6,276**	100	125
65997-15-1	CALCIUM SULFATE HEMIHYDRATE	**2,526**	0	3,986
13530-65-9	ZINC CHROMATE	**752**	13,047	1,857
6484-52-2	AMMONIUM NITRATE	**618**	17,458	338
7790-98-9	AMMONIUM PERCHLORATE	**255**	27,650	35,857
131-74-8	AMMONIUM PICRATE	**0**	4,363	0

Figure 4. NAWCWD Metals Emissions Report

NAWCWD TP 8528

NAVAIR

Metals Emissions From the Open Detonation Treatment of Energetic Wastes

by

T. L. Boggs, T. M. AtienzaMoore, and O. E. R. Heimdahl
Research Department

M. Pepi, J. E. Hibbs, Jr., K. R. Wells, and M. Martyn
Weapons/Targets Department

D. Wooldridge
Ordnance Systems Department

R. L. Gerber
Sverdrup, Inc., Ridgecrest, California

and

L. A. Zellmer and B. M. Abernathy
Environmental Planning and Management Department
Naval Air Weapons Station, China Lake, California

OCTOBER 2004

NAVAL AIR WARFARE CENTER WEAPONS DIVISION
CHINA LAKE, CA 93555-6100

Chemical Compliance Systems, Inc.

Figure 5. Non-Inert Munition Constituent Percentages, 2003–2005

	ALLOY CONSTITUENT	NON-INERT % 2003	NON-INERT % 2004	NON-INERT % 2005
1	ALUMINUM	17	16.6	6.7
2	CARBON	23.6	20.9	22.6
3	CHROMIUM	10	28.66	8.3
4	COPPER	0.05	0.029	0.07
5	IRON	0	0	0
6	LEAD	21	15.29	21.8
7	MAGNESIUM	4.2	5.3	5.2
8	MANGANESE	0	0	0
9	MOLYBDENUM	0	0	0
10	NICKEL	0.5	0.222	0.05
11	PHOSPHOROUS	0	0	0
12	SILICON	0	0	0
13	SILVER	2.6	30.77	39.61
14	SULFUR	47.4	43.76	53.86
15	URANIUM	0	0	0
16	ZINC	0.4	1.78	10.1

Figure 6. Non-Inert Munition Constituent Demiled, 2003–2005

CAS #	CHEMICAL	Non-Inert Demil 2003	Non-Inert Demil 2004	Non-Inert Demil 2005
118-96-7	TNT	**6,624,851**	3,696,266	2,544,068
9004-70-0	NITROCELLULOSE	**6,519,559**	6,184,592	3,326,702
121-82-4	RDX	**1,856,227**	592,376	1,811,744
55-63-0	NITROGLYCERIN	**1,147,398**	771,222	364,636
556-88-7	NITROGUANIDINE	**729,506**	522,523	3,166
693-21-0	DIGLYCOL NITRATE	**560,171**	542,682	193,761
7429-90-5	ALUMINUM	**399,501**	284,341	101,751
7757-79-1	POTASSIUM NITRATE	**113,141**	51,302	89,596
25321-14-6	DINITROTOLUENE	**98,508**	304,767	232,373
84-74-2	DIBUTYLPHTHALATE	**69,364**	206,052	100,254
13114-72-2	METHYL DIPHENYLUREA	**15,811**	15,426	6,666
84-66-2	DIETHYLPHTHALATE	**13,492**	3,657	6
3811-04-9	POTASSIUM CHLORATE	**8,435**	70	86
7790-98-9	AMMONIUM PERCHLORATE	**255**	27,650	35,857
7440-22-4	SILVER	**163**	31	50
131-74-8	AMMONIUM PICRATE	**0**	4,363	0
7440-61-1	URANIUM 238	**0**	0	0
7439-96-5	MANGANESE	**0**	0	0
7723-14-0	PHOSPHORUS	**0**	0	0
7439-98-7	MOLYBDENUM	**0**	0	0
7440-21-3	SILICON	**0**	0	0
7439-89-6	IRON	**0**	0	0

Figure 7. Non-Inert Munition Constituent Demiled Ranking, 2003–2005

CAS #	CHEMICAL	Max Non-Inert Demil	Max Non-Inert Demil Factor	Demil Non-Inert Ranking
118-96-7	TNT	6,624,851	13.56	0
9004-70-0	NITROCELLULOSE	6,519,559	13.53	0
121-82-4	RDX	1,856,227	10.98	19
55-63-0	NITROGLYCERIN	1,147,398	10.14	25
556-88-7	NITROGUANIDINE	729,506	9.40	31
693-21-0	DIGLYCOL NITRATE	560,171	9.00	34
7429-90-5	ALUMINUM	399,501	8.51	37
25321-14-6	DINITROTOLUENE	304,767	8.13	40
84-74-2	DIBUTYLPHTHALATE	206,052	7.62	44
7757-79-1	POTASSIUM NITRATE	113,141	6.90	49
7790-98-9	AMMONIUM PERCHLORATE	35,857	5.70	58
7440-44-0	CARBON	17,227	5.05	63
15748-73-9	LEAD SALICYLATE	13,979	4.88	64
7439-92-1	LEAD	10,379	4.64	66
7439-95-4	MAGNESIUM	1,055	3.18	77
7440-22-4	SILVER	163	2.33	83
7440-61-1	URANIUM 238	0	0.00	100
7439-96-5	MANGANESE	0	0.00	100
7723-14-0	PHOSPHORUS	0	0.00	100
7439-98-7	MOLYBDENUM	0	0.00	100
7440-21-3	SILICON	0	0.00	100
7439-89-6	IRON	0	0.00	100

Figure 8. Weighted Environmental & Chronic Health Regulatory Hazards

WEIGHTED x2	1. Carcinogens 2. Teratogens 3. Neurotoxins

WEIGHTED x1	1. Hazardous Air Pollutants (HAPs) 2. TRI/PBT 3. CERCLA 4. 275 Priority Substances 5. CWA 40 CFR 401.15 6. CWA 40 CFR 117.3 7. DOL Toxic Metals 8. CAL Prop 65—Reproduction

Figure 9. Demiled Munition Constituent Regulatory Hazard Rankings

CAS #	CHEMICAL	REGULATORY RANKING
25321-14-6	DINITROTOLUENE	0
7439-92-1	LEAD	8
84-74-2	DIBUTYLPHTHALATE	17
7440-02-0	NICKEL	25
7440-47-3	CHROMIUM	42
7440-50-8	COPPER	42
122-39-4	DIPHENYLAMINE	42
7439-96-5	MANGANESE	42
3811-04-9	POTASSIUM CHLORATE	42
7439-98-7	MOLYBDENUM	42
693-21-0	DIGLYCOL NITRATE	75
118-96-7	TNT	83
78-11-5	PENTAERYTHRITOL TETRANITRATE	83
149-57-5	2-ETHYLHEXANOIC ACID	83
7790-98-9	AMMONIUM PERCHLORATE	100
7778-80-5	POTASSIUM SULFATE	100
65997-15-1	CALCIUM SULFATE HEMIHYDRATE	100
119-75-5	2-NITRODIPHENYLAMINE	100
13114-72-2	METHYL DIPHENYLUREA	100
57-11-4	STEARIC ACID	100
7440-21-3	SILICON	100
7439-89-6	IRON	100

Figure 10. G-MACS "Green" Score Scheme & Endpoint Criteria

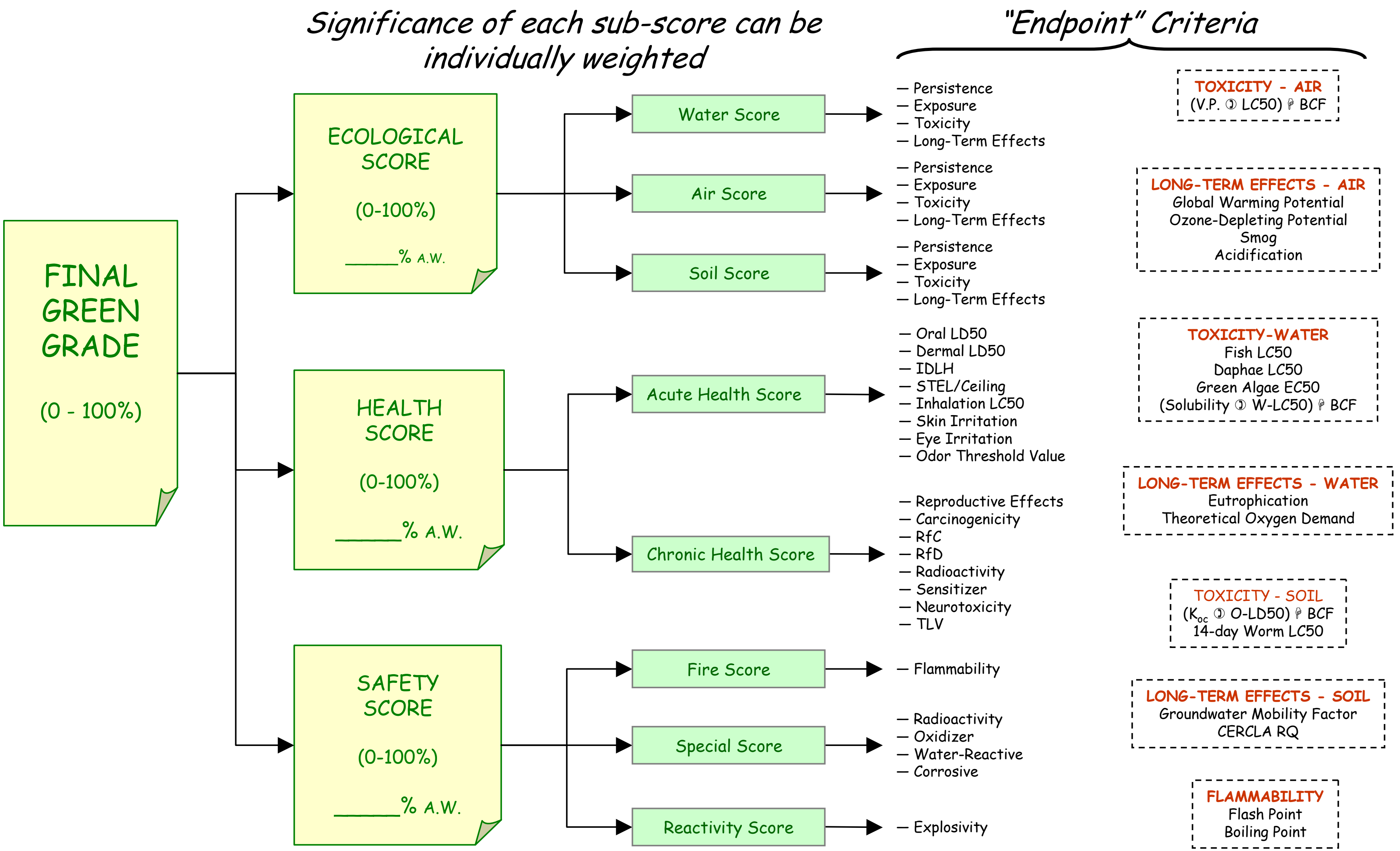


Figure 11. Demiled Munition COCs Ecological Rankings

CAS #	CHEMICAL	AIR	WATER	SOIL	ECOLOGICAL RANKING
131-74-8	AMMONIUM PICRATE	85	23	68	**59**
85-98-3	ETHYL CENTRALITE	96	62	54	**71**
6484-52-2	AMMONIUM NITRATE	85	65	67	**72**
7757-79-1	POTASSIUM NITRATE	85	68	67	**73**
693-21-0	DIGLYCOL NITRATE	89	64	68	**74**
7723-14-0	PHOSPHORUS	85	62	75	**74**
556-88-7	NITROGUANIDINE	96	60	67	**74**
55-63-0	NITROGLYCERIN	87	68	68	**75**
118-96-7	TNT	84	59	80	**75**
121-82-4	RDX	100	59	84	**81**
2691-41-0	HMX	100	60	83	**81**
123-95-5	BUTYL STEARATE	87	69	88	**81**
57-11-4	STEARIC ACID	87	69	88	**81**
7439-89-6	IRON	89	84	74	**83**
7790-98-9	AMMONIUM PERCHLORATE	100	77	84	**87**
7440-44-0	CARBON	100	100	70	**90**
7779-90-0	ZINC PHOSPHATE	100	83	100	**94**
3811-04-9	POTASSIUM CHLORATE	100	93	93	**95**
13530-65-9	ZINC CHROMATE	100	100	100	**100**
65997-15-1	CALCIUM SULFATE HEMIHYDRATE	100	100	100	**100**
9004-34-6	CELLULOSE	100	100	100	**100**

Figure 12. Demiled Munition COCs Health Rankings

CAS #	CHEMICAL	ACUTE	CHRONIC	HEALTH RANKING
25321-14-6	DINITROTOLUENE	50	36	**43**
7440-61-1	URANIUM 238	58	32	**45**
7439-92-1	LEAD	56	43	**50**
7440-02-0	NICKEL	58	44	**51**
55-63-0	NITROGLYCERIN	46	68	**57**
13530-65-9	ZINC CHROMATE	80	38	**59**
7440-50-8	COPPER	53	67	**60**
7440-47-3	CHROMIUM	55	65	**60**
118-96-7	TNT	60	64	**62**
7439-96-5	MANGANESE	64	61	**63**
15748-73-9	LEAD SALICYLATE	94	53	**74**
121-82-4	RDX	74	88	**81**
2691-41-0	HMX	85	99	**92**
556-88-7	NITROGUANIDINE	94	97	**95**
7790-98-9	AMMONIUM PERCHLORATE	96	99	**98**
3811-04-9	POTASSIUM CHLORATE	98	99	**99**
7778-80-5	POTASSIUM SULFATE	98	99	**99**
7439-89-6	IRON	99	99	**99**
7757-79-1	POTASSIUM NITRATE	99	99	**99**
13114-72-2	METHYL DIPHENYLUREA	100	99	**100**
7439-95-4	MAGNESIUM	100	99	**100**
9004-70-0	NITROCELLULOSE	100	99	**100**

Figure 13. Demiled Munition COCs Safety Rankings

CAS #	CHEMICAL	FIRE	REACT	SPECIAL	SAFETY RANKING
2691-41-0	HMX	0	0	75	**25**
118-96-7	TNT	0	0	100	**33**
131-74-8	AMMONIUM PICRATE	25	0	75	**33**
556-88-7	NITROGUANIDINE	0	0	100	**33**
6484-52-2	AMMONIUM NITRATE	25	0	75	**33**
121-82-4	RDX	25	0	100	**42**
9004-70-0	NITROCELLULOSE	25	0	100	**42**
55-63-0	NITROGLYCERIN	50	0	100	**50**
78-11-5	PENTAERYTHRITOL TETRANITRATE	75	0	75	**50**
7429-90-5	ALUMINUM	25	50	75	**50**
7790-98-9	AMMONIUM PERCHLORATE	100	0	75	**58**
7439-95-4	MAGNESIUM	75	25	100	**67**
85-98-3	ETHYL CENTRALITE	75	51	100	**75**
15748-73-9	LEAD SALICYLATE	75	100	100	**92**
7439-89-6	IRON	100	100	100	**100**
7439-92-1	LEAD	100	100	100	**100**
7440-47-3	CHROMIUM	100	100	100	**100**
7440-50-8	COPPER	100	100	100	**100**
119-75-5	2-NITRODIPHENYLAMINE	100	100	100	**100**
13114-72-2	METHYL DIPHENYLUREA	100	100	100	**100**
598-63-0	LEAD CARBONATE	100	100	100	**100**
7778-80-5	POTASSIUM SULFATE	100	100	100	**100**
7779-90-0	ZINC PHOSPHATE	100	100	100	**100**

Figure 14. Combined COC Ratings & Composite Rankings

CAS #	CHEMICAL	Demil Non-Inert Ranking	Regulatory Ranking	Eco	Health	Safety	COMPOSITE RANKING
25321-14-6	DINITROTOLUENE	40	0	75	42	67	**224**
118-96-7	TNT	0	83	74	62	33	**252**
55-63-0	NITROGLYCERIN	25	50	75	57	50	**257**
121-82-4	RDX	19	50	81	81	42	**273**
7439-92-1	LEAD	66	8	77	42	100	**293**
84-74-2	DIBUTYLPHTHALATE	44	17	82	71	92	**305**
7429-90-5	ALUMINUM	37	75	82	75	50	**319**
9004-70-0	NITROCELLULOSE	0	100	82	100	42	**324**
556-88-7	NITROGUANIDINE	31	100	74	95	33	**333**
7440-02-0	NICKEL	80	25	82	51	100	**338**
2691-41-0	HMX	54	100	81	92	25	**352**
7757-79-1	POTASSIUM NITRATE	49	75	73	99	67	**363**
15748-73-9	LEAD SALICYLATE	64	58	85	74	92	**373**
7790-98-9	AMMONIUM PERCHLORATE	58	100	81	98	58	**395**
102-76-1	TRIACETIN	53	100	80	97	92	**422**
57-11-4	STEARIC ACID	68	100	82	92	92	**434**
7778-80-5	POTASSIUM SULFATE	53	100	85	99	100	**437**
65997-15-1	CALCIUM SULFATE HEMIHYDRATE	71	100	100	85	83	**439**
119-75-5	2-NITRODIPHENYLAMINE	66	100	80	97	100	**443**
13114-72-2	METHYL DIPHENYLUREA	63	100	80	100	100	**443**
7440-21-3	SILICON	100	100	82	92	75	**449**
7440-44-0	CARBON	63	100	90	99	100	**452**
7439-89-6	IRON	100	100	83	99	100	**482**

Figure 15. Ammonium Perchlorate Data Assessment

NAS REPORT

- Perchlorate only affects the thyroid gland
- >245 ppb perchlorate inhibits thyroid iodine uptake—NOT adverse/harmful effect
- Requires 400 gal/d with 20 ppb perchlorates
- No evidence brain damage, birth defects, nor cancer in humans
- Perchlorates are not stored/accumulated in the body
- Thyroid effects reverse once exposure stopped/reduced
- “Reference Dose” (= safe/day x lifetime for everyone) = 24.5 ppb

OTHER

- American Thyroid Association press release 10/1/04: perchlorates may not be as harmful to newborns, pregnant women and other adults as previously thought
- EPA 2006 “Drinking Water Equivalent Level” and “Cleanup Guidance” = 24.5 ppb
- Perchlorate used to treat hyperthyroidism since 1950s – >70,000 ppb
  - administered frequently
  - rapidly eliminated from the body

Figure 16. Recommended Minimal DoD Test Data

- FDA Drug Requirements:
  - Pharmacological Efficacy (5)
  - Preclinical Toxicity (10-15)
  - Clinical (Phase I)

- EPA Pesticide Requirements:
  - Residue Chemistry (6)
  - Animal Toxicity (5-10)
  - Nontarget Organism Toxicity (5-7)

- Recommended DoD Energetic Requirements:

ECOLOGICAL	HEALTH	SAFETY
Water Solubility	Acute Toxicity (2 Species)	Flashpoint
Vapor Pressure	Subchronic Toxicity	Boiling Point
Octanol/Water Partition	Teratogenicity/Reproduction	pH
Melting Point	Metabolism	Explosivity
Boiling Point		
96-Hour Guppy LC50		
96-Hour Green Algae EC50		
48-Hour Daphnia LC50		
14-Day Earthworm LC50		

Figure 17. Comparison of FY01[a] & FY06[b] COCs

- 38 COCs in Both Analyses
- 13 COCs in FY01 Analysis, NOT FY06 (7 Metals)

Antimony	Hafnium	Tetryl
Cadmium	Polytetrafluoroethylene	Tin
Charcoal	Potassium Perchlorate	Titanium
Cobalt	Sodium Nitrate	Zirconium
Graphite		

- 9 COCs in FY06 Analysis, NOT FY01

Ammonium Nitrate	Diethylphthalate	2-Nitrodiphenylamine
Calcium Sulfate Hemihydrate	Diglycol Nitrate	Potassium Chlorate
Cellulose	Methyl Diphenylurea	Silver

---

[a] encompassed CY99 & CY00
[b] encompassed CY03, CY04 & CY05

MACS Identification of Chemicals of Concern

For a remote demonstration, or more information, contact…

Dr. George Thompson
973-663-2148
georgethompson@chemply.com

Chemical Compliance Systems, Inc.
706 Route 15 South, Suite 207• Lake Hopatcong, NJ 07849
www.chemply.com

SPREEWERK

Demilitarization Technologies: Past, Present and Future

Authors & Presentors:

Michael Garner and Hermann G.Tritsch

Global Demil Symposium ~ Indianapolis, Indiana, May 2006

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WOJEWÓDZTWO LUBUSKIE
WOJEWÓDZTWO DOLNOŚLĄSKIE

SPREEWERK

- Over 10,000 ICM munitions destroyed


<u>Bombs</u>
<u>M64 – MK84</u>

Artillery rounds/ projectiles

Hawk

MLRS

White Phosphorus

- Over 32,000 Explosive D munitions destroyed

- Over 6,000 CBU's destroyed

More than ANY demil facility in the world!



AT / AP land mines

Nike/Hercules

Demilitarization ~ Past:

- Open Burn / Open Detonation

- Deep Sea Dumping
- Primative disassembly

SPREEWERK

Demilitarization ~ Past

~ Results ~

→Environmental hazards and contanimation
→Contamination of Soil, Air and Water
→Relatively little or NO pay back value to client and/or Govt.

SPREEWERK

Demilitarization ~ Present:

~ Goal ~

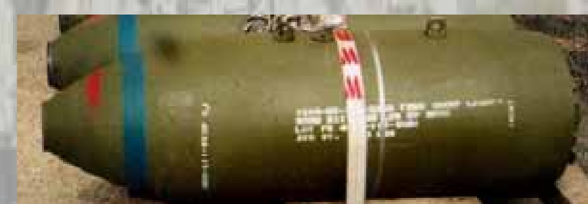
- ✓ Safe Operation
- ✓ Environmentally friendly
- ✓ Avoiding Contamination
- ✓ Maximize R^3

SPREEWERK

Demilitarization ~ Present:

Example of safe and effective demilitarization:
~ Bomb disposal ~

- **Spreewerk has successfully processed over 15,000 bombs of various calibers (500lbs, 750lbs, 1000lbs)**
  - → **Steel Cases**
  - → **Explosives: Tritonal, TNT**



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Demilitarization ~ Present:

Example of safe and effective demilitarization:
~ Bomb disposal ~

Present day demil / bomb disposal needs:

1. Safe & environmentally safe
2. Maximize R3 **(possibly reuse for future military munitions)**
   → All scrap
   → Recycle & re-use the explosive charge(s)

Recycled explosive is often sold on the commercial market, however to recycle material back to military use (other than donor material), the extraction and processing must not allow for high level(s) of contamination

SPREEWERK

Demilitarization ~ Present:

Currently, most bomb demil incorporates an Autoclave process

→Major issue with this process is that the explosive charge mixes with the asphalt and filler, often contaminating the H.E.

Subsequently, the payback value to the Government is very low (in terms of reuse into other munitions)

SPREEWERK

<u>Demilitarization ~ Present</u>:

The major goal of improving the process is:

1. Avoid the mixture of asphalt and filler

   (thus allowing the recycling & reprocessing efforts greater opportunity for reuse into other munitions)

2. Increase performance

   (due to the limited amount of time required to demil each item)

Demilitarization ~ Present:

Results of improved demil process:

1. Higher payback value to the Government
2. H.E. / Tritonal without contamination
   (Can be reprocessed into Type III TNT)

SPREEWERK

Demilitarization ~ Present:

Example of improved bomb demil:

Bomb body ready for processing

→Rather than using an autoclave system, bomb(s) will be cut and/or broken into sections

Example: M117 bomb

Demilitarization ~ Present:

Example of improved bomb demil cont.

After cutting and/or breaking, bomb parts will be transported to either melt out* facility or press out facility

Melt out* of tail section

SPREEWERK

Demilitarization ~ Present:

Recovered explosives packaged and ready for transport to explosives recycler

SPREEWERK

<u>Demilitarization ~</u>
Present & Future

- The Quantity and Location of the Material causes large Freight Rates
- Production areas need to be installed close to the user or near item storage location
- Search for Partnership Solutions (ATK, Explos Systems & ISL)

SPREEWERK

Demilitarization ~ Present

- **Technology Transfer to Explo Systems**
  - Teamed with ISL to construct a state of the art demil line to dismantle M117 GP bombs
    - donor source for this effort.
  - State of the art demil facility, is the only such line outside its sister line in Germany
  - Explo is currently under contract to Alliant Techsystems to produce TNT from Tritonal.

Cutting Devices

SPREEWERK

Demilitarization ~ Present

•**Breaking/cracking device**

- **Technology Transfer to Explo Systems**
  - Explo's responsibility is for the dismantling and recovery of the component parts of over 13,000 M 117 Bombs
  - Explo is a second tear subcontractor under ISL, who is contracted with Alliant Techsystems, (the Prime Contractor to the United States government)

•**Pressing Devices**

SPREEWERK

Demilitarization ~ Present

- **Technology Transfer to Explo Systems**
  - Transfer of this technology represents a step forward in the establishment of a viable commercial demil operation for bombs in the US

Melting Device

SPREEWERK

Demilitarization ~ Present

- **Explo Systems knows how to recover the TNT from Tritonal**
  - Explo investment: approx. $1,300,000
    - site preparation and machinery to accomplish this effort.

SPREEWERK

Demilitarization:
Future Actions

- Continue to search for new methods of safe and secure demil
- Continue to maximize R3
  - ✓ Including possible reuse of product back into future munitions
- Continue to maximize partnership
  - ✓ Doing so maximizes opportunity to reuse product back into new munitions
  - ✓ Possibly work with producers for total lifecycle efforts

SPREEWERK

~ Conclusion ~

→Learn from the demil actions of the past

→Accomplishments and failures

→Continue to develop new methods

→Transfer of technologies

→Form key partnerships

→Don't ignore proven methods that allow high R3

→Try to incorporate proven methods

→Try to offer high payback value to Government/Client

SPREEWERK

Questions??

SPREEWERK

GENERAL DYNAMICS
Ordnance and Tactical Systems

14th Global Demil Symposium
May 1 – 5, 2006

DEMILITARIZATION

Operational Adaptability
in
Demil Engineering

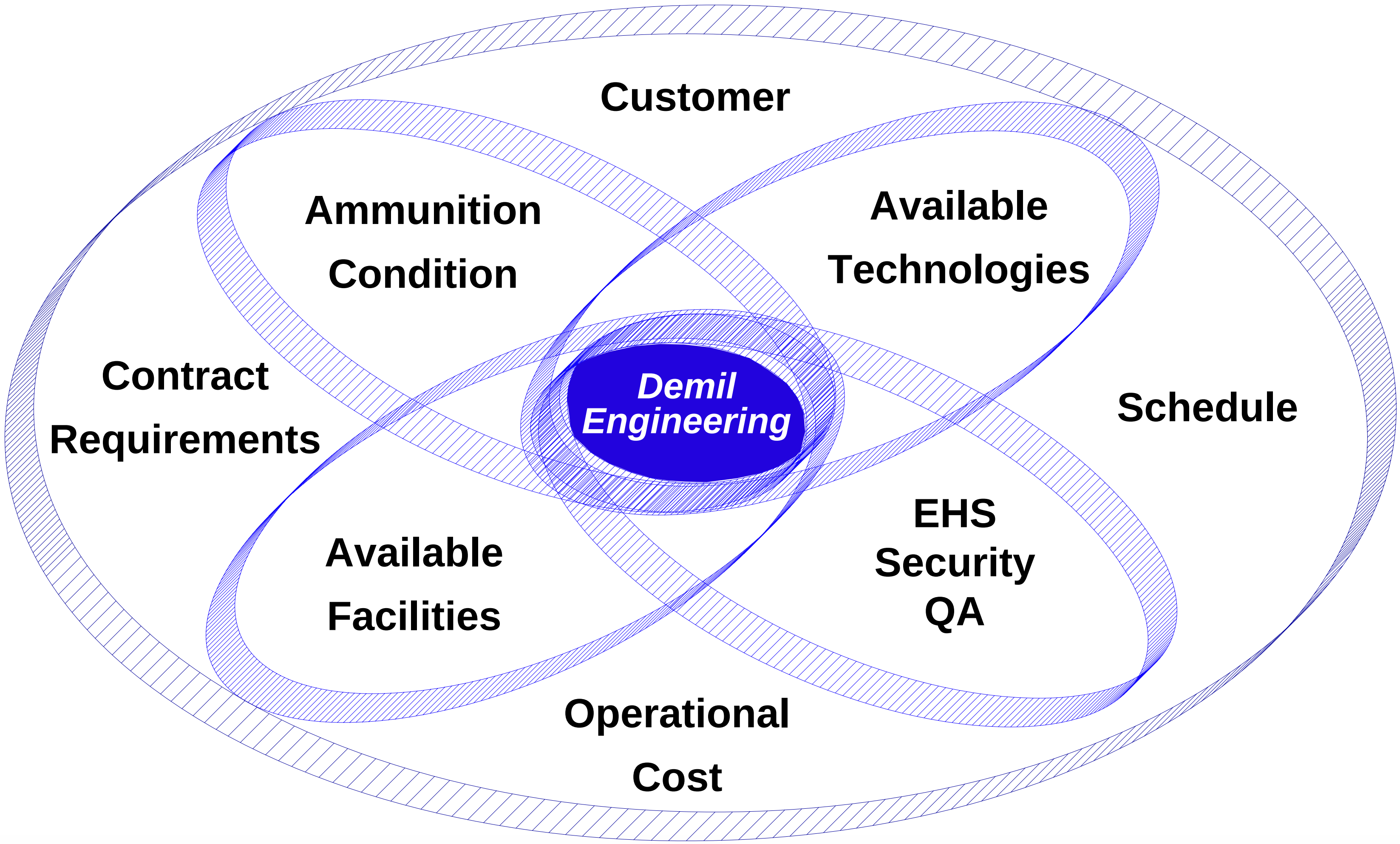
14th Global Demil Symposium

May 1 – 5, 2006

Wilfried Meyer
Demil Program Manager
727-578-8304
wmeyer@gd-ots.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

Demil Engineering Variables



Demil Engineering Tools

GD-OTS Level
- Engineering Pool
- Risk Management Board
- R&D
- Financial Backing

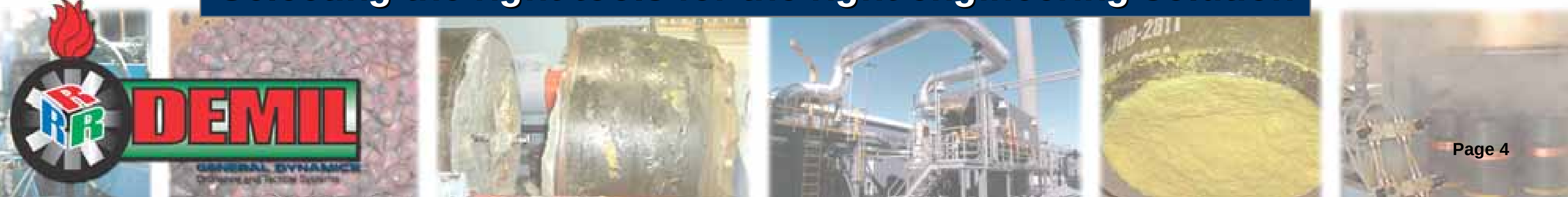
Experience
- Demil Experience IDIQ I
- Supplier Demil Experience
- Ammunition Experience

Individual Level
- Knowledge/Expertise
- Communication
- Subject Matter Expert

Program Level
- IPT Eng Team Meetings
- Value Engineering
- Six Sigma Projects
- Supplier Visits & Audits

Support Tools
- GD-OTS Demil Database
- MIDAS
- Customer Experts
- Engineering Consultant

Selecting the right tools for the right engineering solution



Major Demil Project Phases

Evaluation

- MIDAS
- Ammo Data Cards
- Process Lay-out
- Risk Analysis
- EHS Compliance

Facilitization

- Facilities
- Equipment
- Line Installation
- Waste streams
- Process Plans
- Training

Prove-out

- Engineering Testing
- Walk-through
- Low-rate production

Production

- Performance Evaluation
- Process Improvements

Demil Engineering Challenges due to External Factors

Demil Operations
GD-OTS

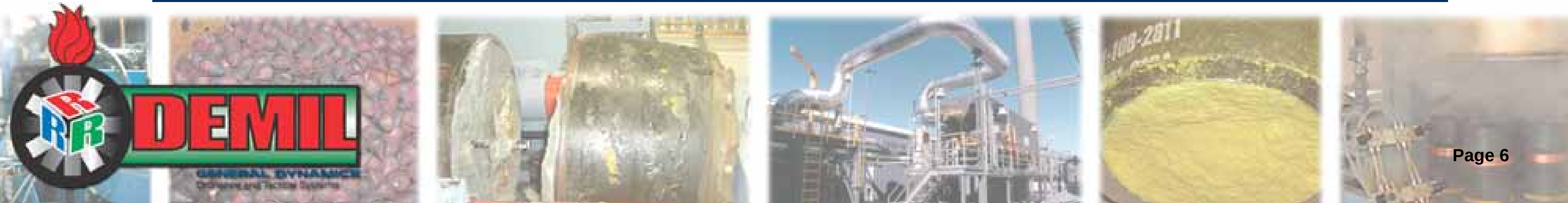
Fuzes	Explosive D	ICM	Prop Charges
ICI EBV EEC	EBV ISL	EBV EBV EEC	TPL

Small Cal	Pyrotechnics	HE Cartridges	Bulk Prop	Bombs
GD-OTS ICI EBV EEC	TPL	EBV ISL EBV EEC	TPL	GD-ATP EBV ISL

Engineering Challenges

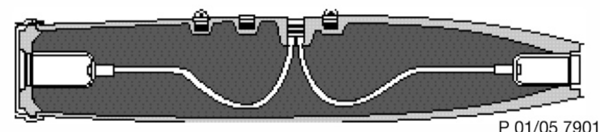
- 9 Ammunition families with 54 different types of ammunitions
- 17 operational Demil lines at 7 different suppliers
- 6 changes of place of performance within less than four years

Sustained safe and effective Demil Operations at all places

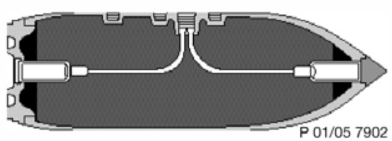


Demil Processing Bombs

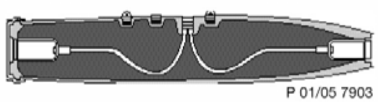
HE Bombs Family



F127, F272 MK 84 2000 lbs

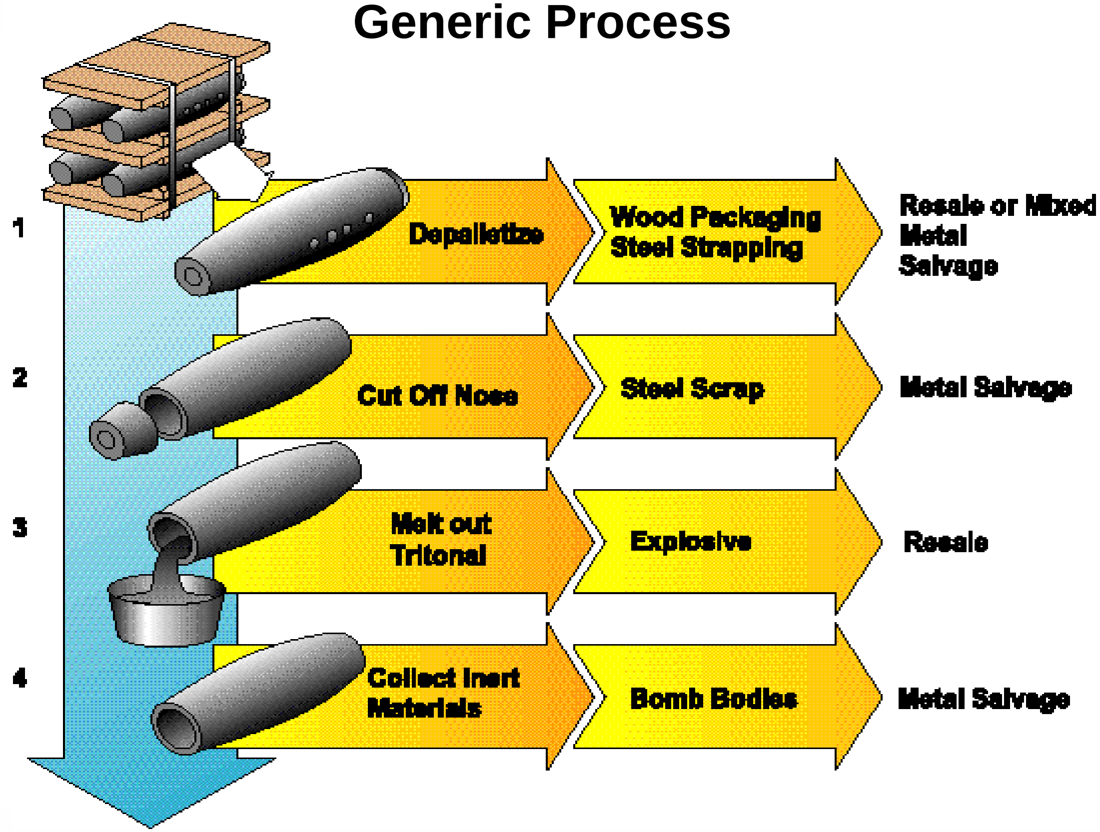


F114 M117 750 lbs



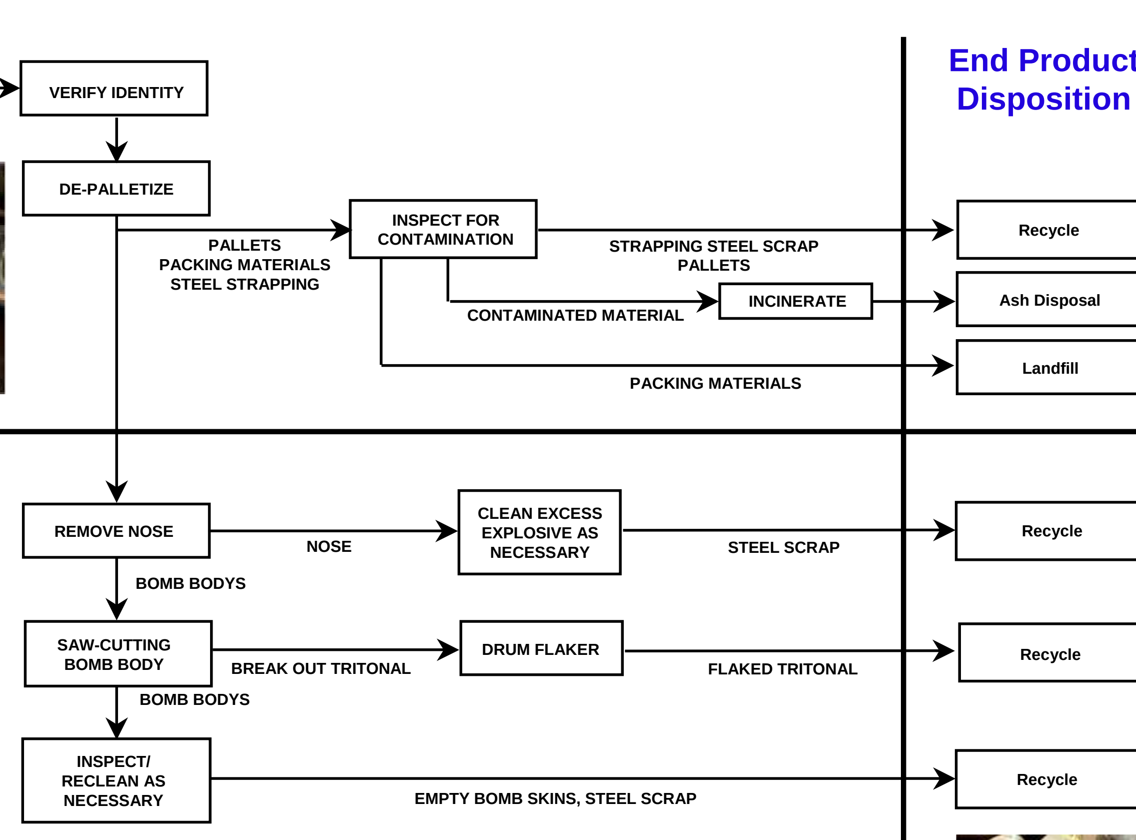
E480 MK82 500 lbs

Generic Process



Typical Bomb Demil Process Lay-out

Material Preparation



End Product Disposition

Processing

Equipment Installation and Processing

Bomb Saw-Cutting

Sectioned Bomb

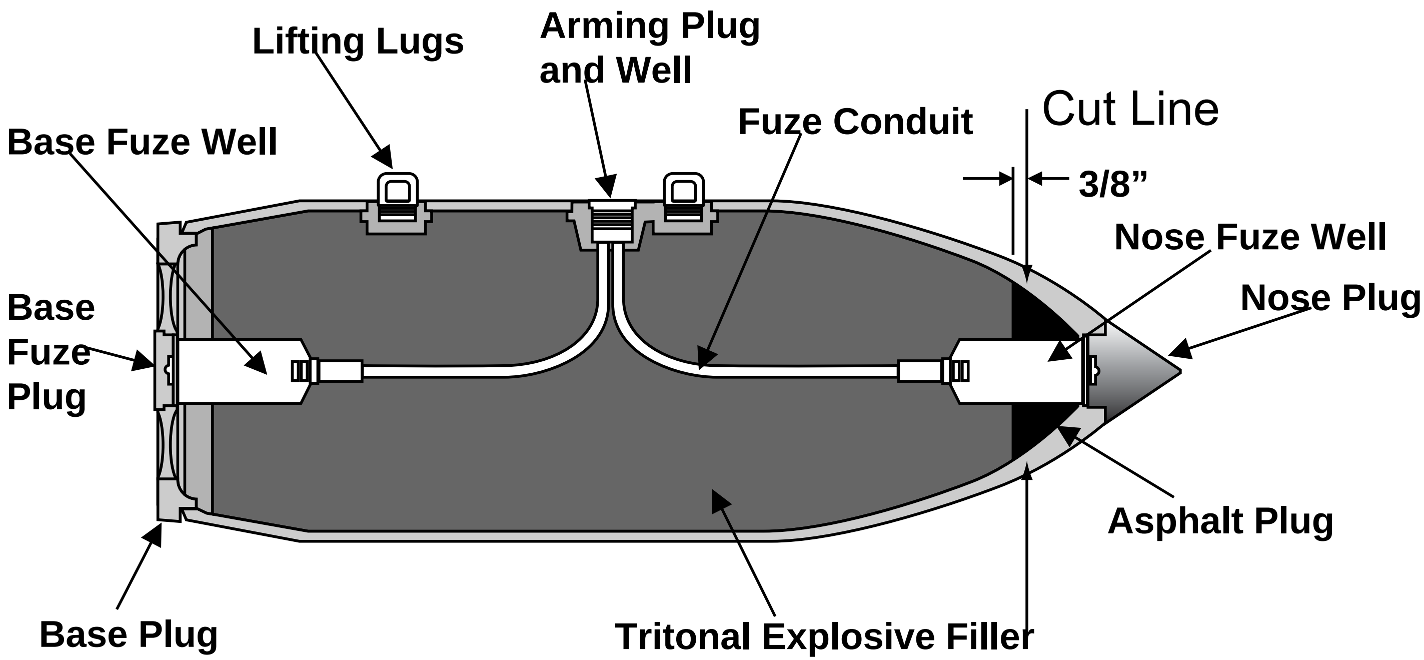
Section Break-out

Cut Nose Section

Removed TNL

Bomb Processing at GD-OTS Camden

- Processed 8056 F114 750 lbs Bombs from 2000 to 2003
- Recovered about 3 million lbs of Tritonal and 1,100 tons of steel



Recovery and Recycling

Sectioned Tritonal

Bomb Shell for Recycling

Flaked Tritonal

Stored HE Ready for Reuse

Demil Engineering Challenge

Received 800 1953 “Vintage” Bombs in 2001

- **Non-homogeneous distribution**
- **No asphalt liner**
- **3 “zones” of explosive material**

TNL Knock out process and fracture process was not working properly

- ➢ **Increase segment cuts**
- ➢ **Up-graded Knock out / fracture devices**

=> Process was not robust and safe enough

Development of 2nd Bomb Demil Line

Successful Engineering Team Effort to establish new line:

- **Evaluated Process Capabilities at supplier in Germany**
- **Discussed-coordinated new process approach with JMC**
- **Established new production line**
- **Shipped vintage bombs to Germany**
- **Tested and proved-out production**
- **Accomplished within 12 months**

Saw cutting

Under water cutting

Development of 2nd Bomb Demil Line

Press-out large sections

Break-out small sections

Development of 3rd Bomb Demil Line

Due to financial difficulties at the 2nd supplier we had to switch again to 3rd supplier

- **Evaluated Process Capabilities at 2nd supplier in Germany**
- **Established new Demil Plans and Production Lines**
- **Obtained Permits for new processes**
- **Engineering testing and low rate production**
- ➔ **Accomplished in less than 6 months**
- ➔ **Successfully completed 3916 Bombs from 2004 to 2005**

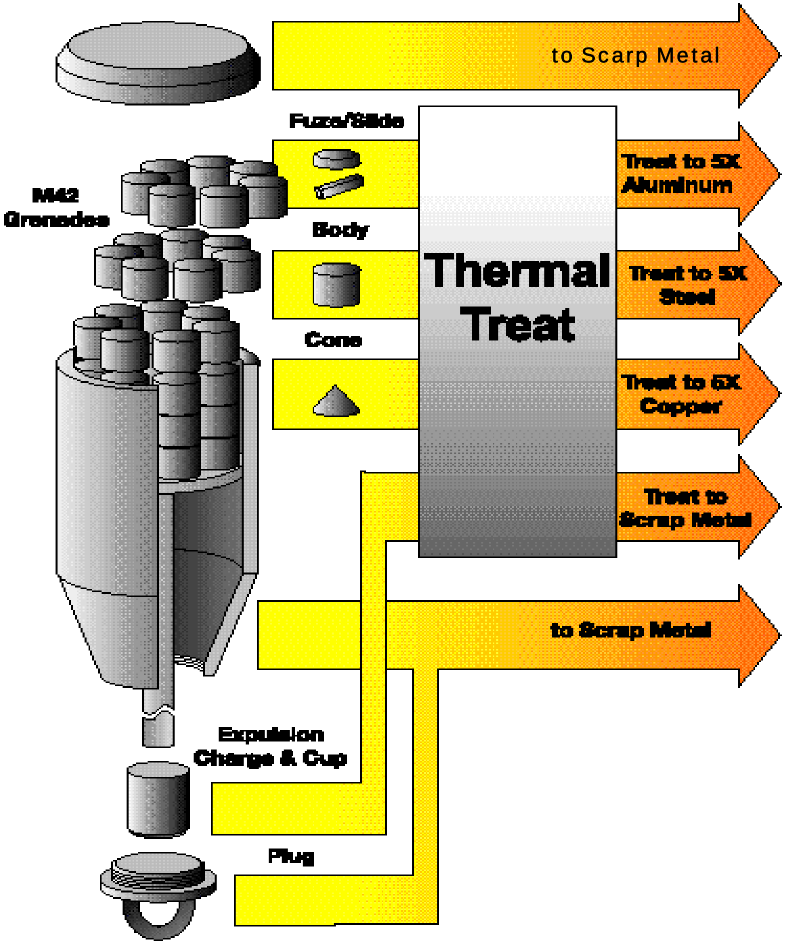
Nick cutting

Press-out and Melt-out

Demil Processing ICM

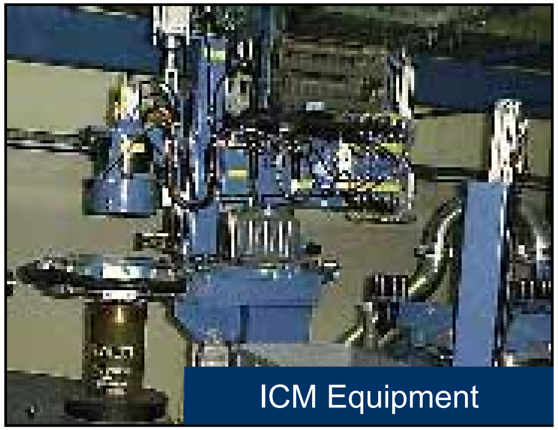
ICM M 483 Projectile (D563)

Grenade M42/46



Installation of ICM line in Germany


Before Facilitization


ICM Equipment


After Facilitization


Base Plate Removal

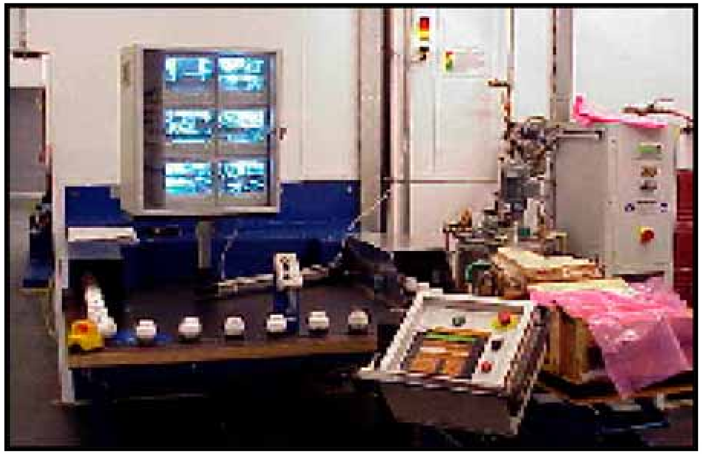

Grenade Removal

DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

Production Performance ICM Line

- After installation, prove-out and start-up of the line our supplier demiled about 44,000 rounds (3.9 million grenades)
- Due to financial difficulties of the supplier the factory shut-down
- Parts of the original ICM line were used in a complete re-design and a "new" line was shipped to the US to EBV EEC

Installation of new ICM line in U.S.

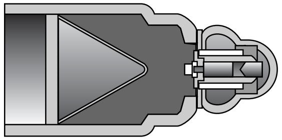


- **The total redesign, manufacturing, engineering testing and prove-out was accomplished within 12 months**
- **The line is fully automated and runs at about 2,800 projectiles per month**
- **From Mar 04 to Oct 05 we demiled 44,001 projectiles with a total of 3,872,088 grenades**

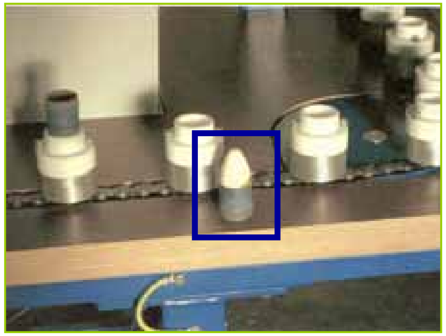
Process Safety Improvement

- Replacing remote shearing-off the fuze slider mechanism to locking the fuze and arming mechanism with an Epoxy

Grenade M42/46



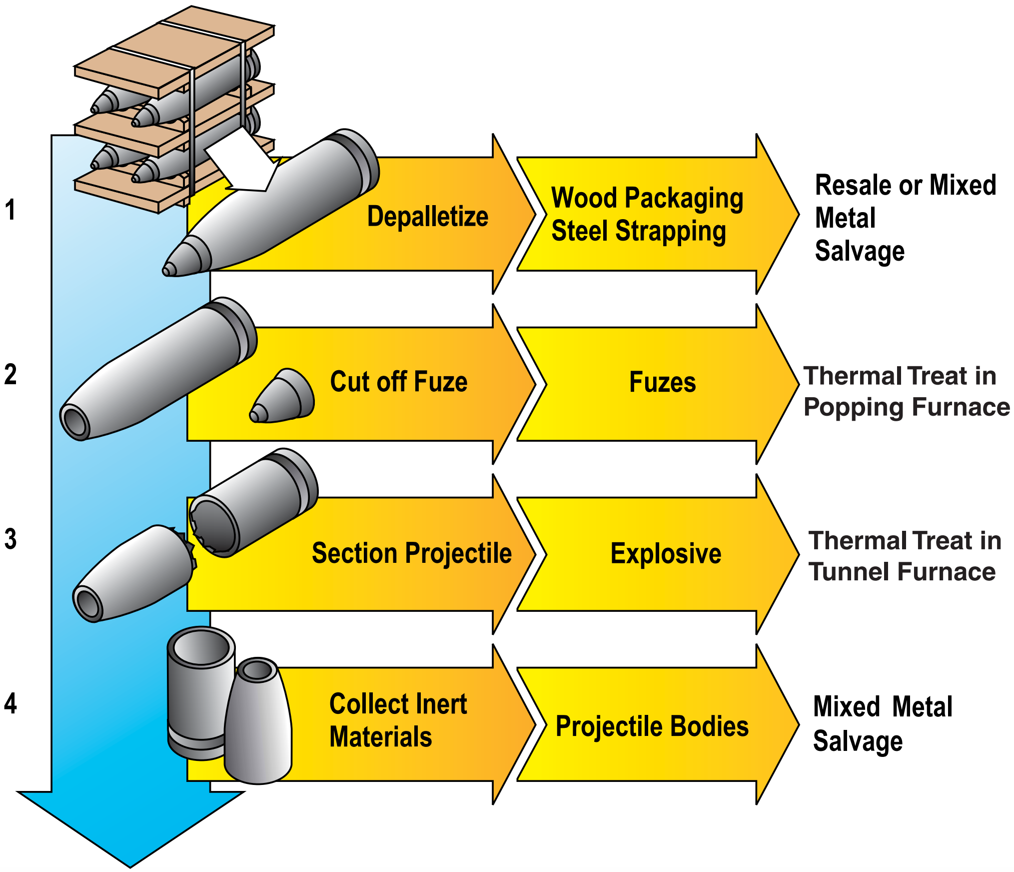
Fuze Mold – Epoxy Fill



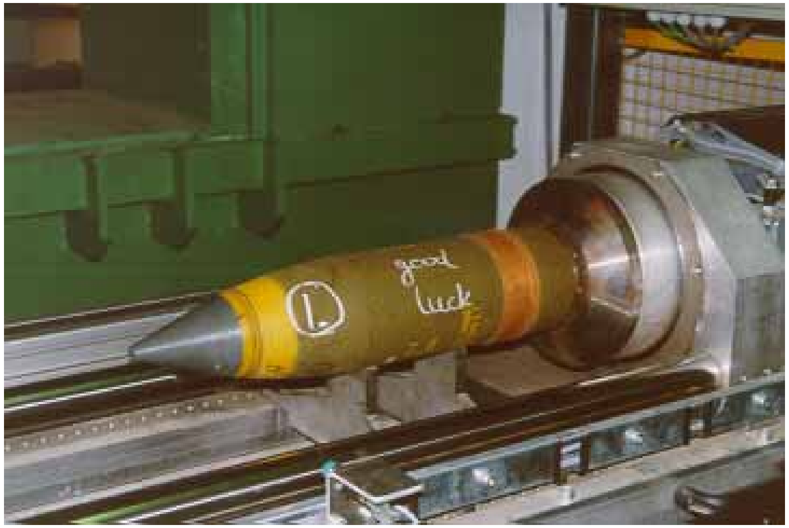
Fuze is Epoxy Locked

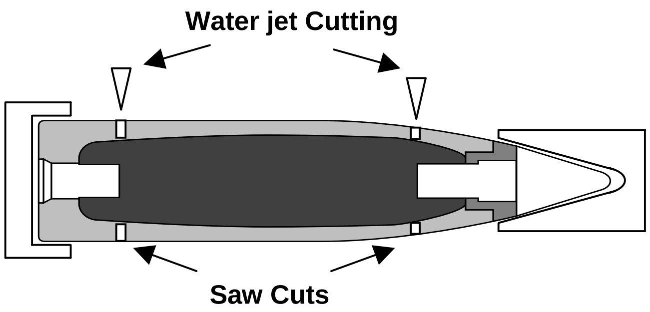
Demil Processing Explosive D

Generic Demil Process



Installation of 1st Explosive D Line





- **Fuze unscrewing**
- **Saw-cutting and abrasive water jet cutting**
- **Thermal Treatment of Explosive D in Tunnel furnace**
- **Metal recycling**
- **Processed 43,204 units from Dec 99 to June 02**

Installation of 2nd Explosive D Line at ISL

Major Process Steps:

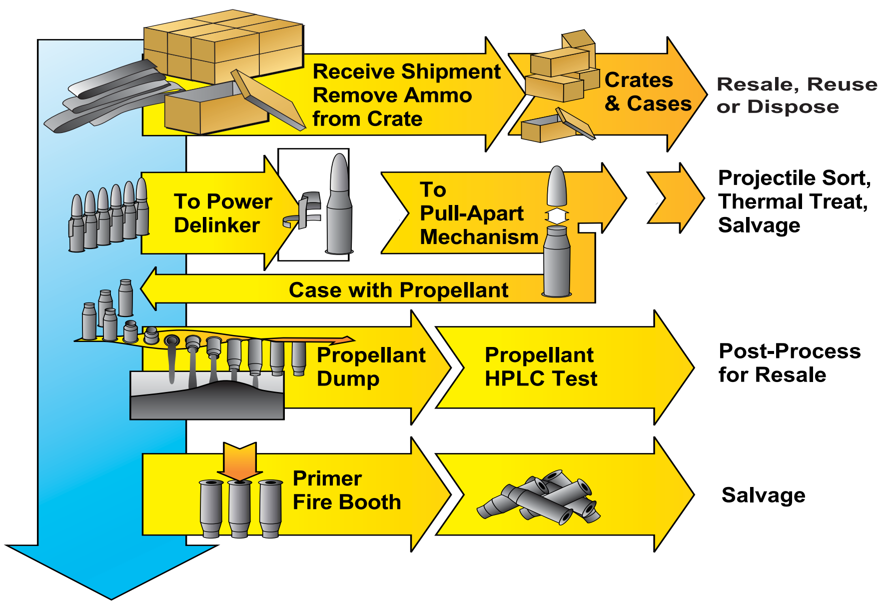
- **Fuze unscrewing**
- **Nick-cutting**
- **Thermal Treatment of Explosive D in Rotary Kiln**
- **Processed 16,386 units from Jun 03 to Mar 05**

Process Improvement: Avoiding Water/Explosive D mixture improved safety and process through-put

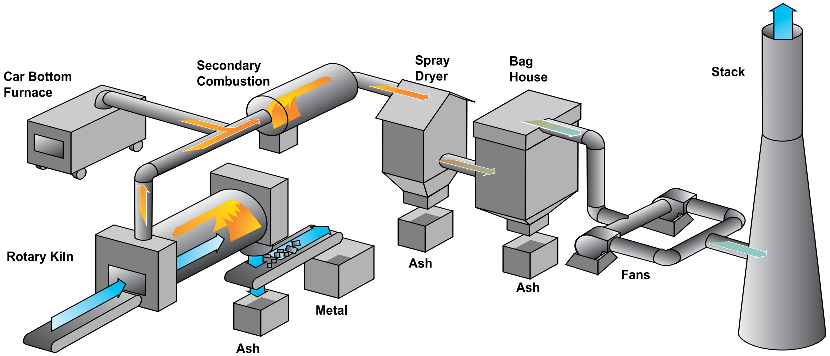
Process Changes Small Cal

Necessary supplier switch with process change from pull-apart with propellant recycling to thermal treatment in rotary kiln system due to economic reasons

Pull-apart



Rotary Kiln Incinerator



Practical Engineering Solutions

Propellant "Sensor"

Propellant Can Crushing

Deteriorated Ammunition

Deteriorated Ammunition Boxes


105 mm HE Cartridge

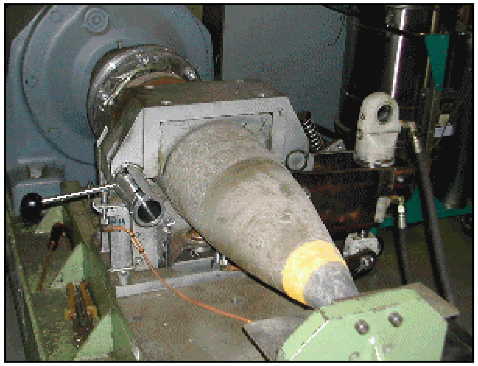

Corroded Catridges

Wet Propellant Bags


Corroded Warheads

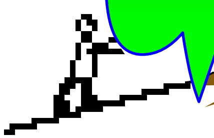
Operational Adaptability

- GD-OTS demiled more than 43,900 tons (13.4 million units)
- Without any explosive mishaps, injuries, facility damages or environmental violations
- No munitions items were lost or stolen.
- Adaptability in demil processes did not compromise Environmental, Health, Safety and Security



Demil engineers will find the right solution

GD-OTS Demil Team



QUESTIONS?


GENERAL DYNAMICS
Ordnance and Tactical Systems
14th Global Demil Symposium
May 1 – 5, 2006

DEMILITARIZATION

A "Hands On" Approach To Safety Program Management

14th Global Demil Symposium

May 1 – 5, 2006

Richard B. Witiak
Demil Program Safety Manager
727-578-8300
rbwitiak@GD-OTS.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

“Hands On Approach”

Program Management and Prime Responsibilities

- **DFARs 252.223-7002 252.223-7002 “Safety Precautions for Ammunition and Explosives”- g (2):**

  “The Contractor agrees to ensure that the subcontractor complies with all contract safety requirements. *<u>The Contractor will determine the best method</u>* for verifying the adequacy of the subcontractor's compliance.”

“Hands On Approach”

- **Use only Safe, Environmentally Friendly and Effective Technologies for Resource Recovery and Recycling (R³)**

“Hands On Approach”

Safety Program Management Elements

“Hands On Approach”

- **There is <u>NO</u> Substitute for Being There**
- **We constantly asked and answered the essential “classics”**

Who ? → What ? → When ?

Where? → How ? → Why ?

“Hands On Approach”

There is <u>NO</u> Substitute for Being There

Words per Demil Plan:

1.	Explosives D	10,886 words
2.	Bombs	9,226 words
3.	ICM	8,376 words
4.	Pyro’s	5,386 words
5.	Propellant	5,374 words

“Hands On Approach”

There is <u>NO</u> Substitute for Being There

Explosives D Process - 10, 886 words

So…..How many words is this picture worth ?

“Hands On Approach”

Explosives D Process - 10, 886 words

Our <u>Being There</u> was Planned – Productive – Effective

Demil Planning

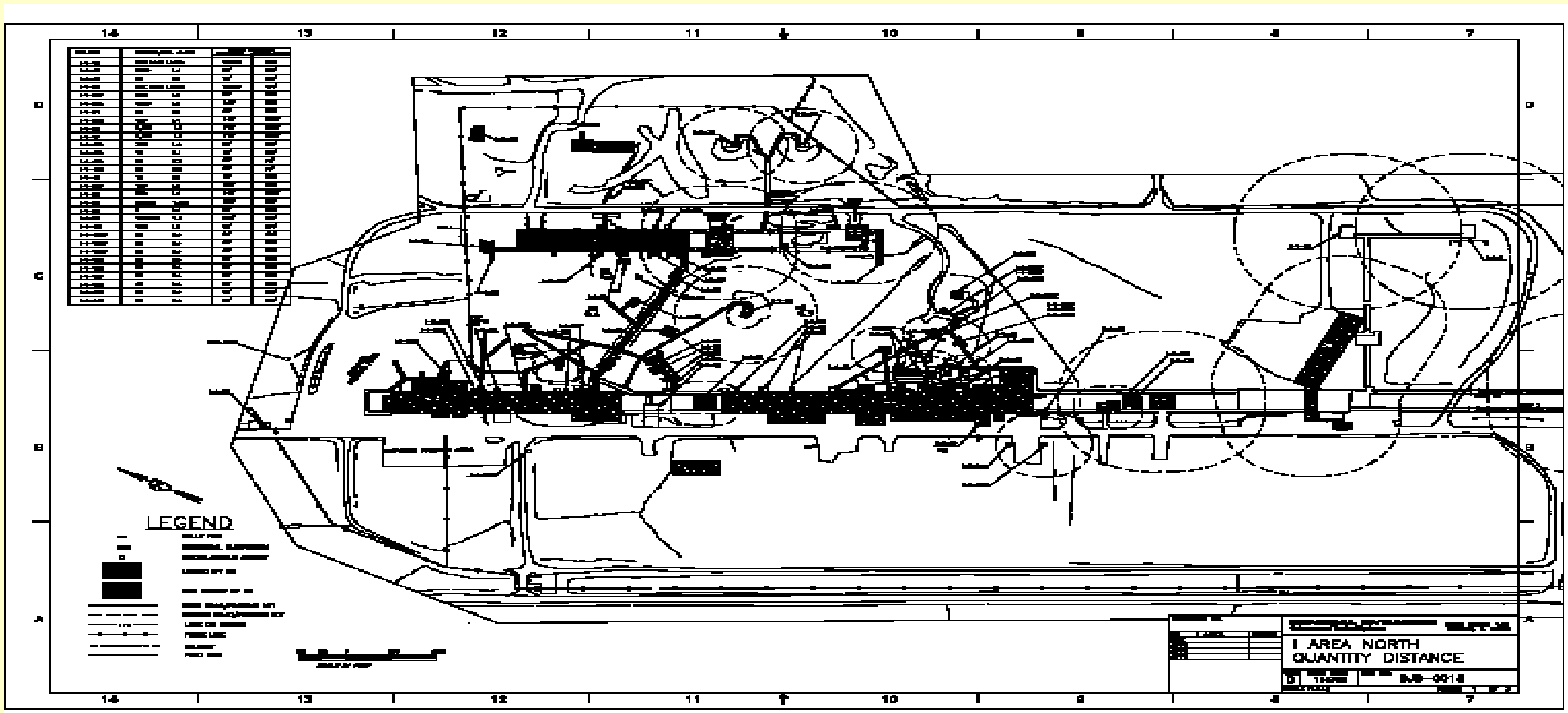
The Best "Opportunities" for Safety start here:

- On-site pre-selection evaluations for capability to comply
- Initial site plan and facility evaluations for Quantity Distance and facility construction
- Initial storage location(s) evaluation for Quantity Distance
- Submission of compliant site plans
- Hazards Analysis for each operation; FMEA's - OSHA PSM - MIL-STD-882D
- Development of "Acceptable Demil Plans"

	HAZARD PROBABILITY				
HAZARD SEVERITY	Frequent	Probable	Occasional	Remote	Improbable
Catastrophic	HIGH	HIGH	HIGH	HIGH	MEDIUM
Critical	HIGH	HIGH	HIGH	MEDIUM	LOW
Marginal	HIGH	MEDIUM	MEDIUM	LOW	LOW
Negligible	MEDIUM	LOW	LOW	LOW	LOW

Demil Planning

The Best "Opportunities" for Safety start here:
Submission of compliant site plans



Demil "Doing"

Plan on Doing it On-Site and Right

- **We did on-site safety pre-award audits**
- **We did on-site safety assistance visits and audits**
- **We did on-site safety pre-operational reviews**
- **We co-coordinated our safety audits and visits with DCMA Safety whenever possible**
- **We visited our JMC/AFSC customers on Demil Plans and other safety and technical issues**
- **We never settled for "OK" in safety issues**
- **We always insisted on Better than - or - Equal to**

Demil Checking

We always asked “How Well are We Doing ?

- We used “Safety by Design” as the criteria
- Engineering hazards out of processes remains our goal
- Demil Plans and procedures were the documents
- On-Site audits and assistance visits were the tools
- We always worked towards finding solutions
- We developed and maintained a cooperative approach to checking on conformance and compliance
- We stayed “Flexible” where possible but “Firm” when needed for “Safety’s Sake”

Demil Checking

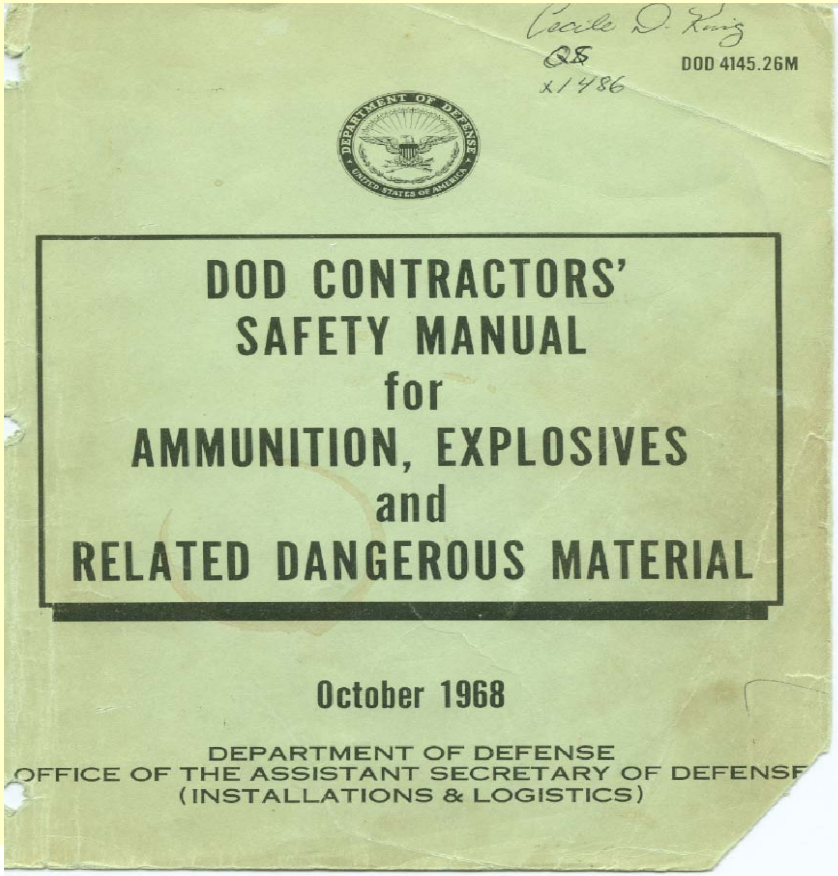
“Safety by Design”

Demil Checking

"Safety By Design, However…"

Demil Checking

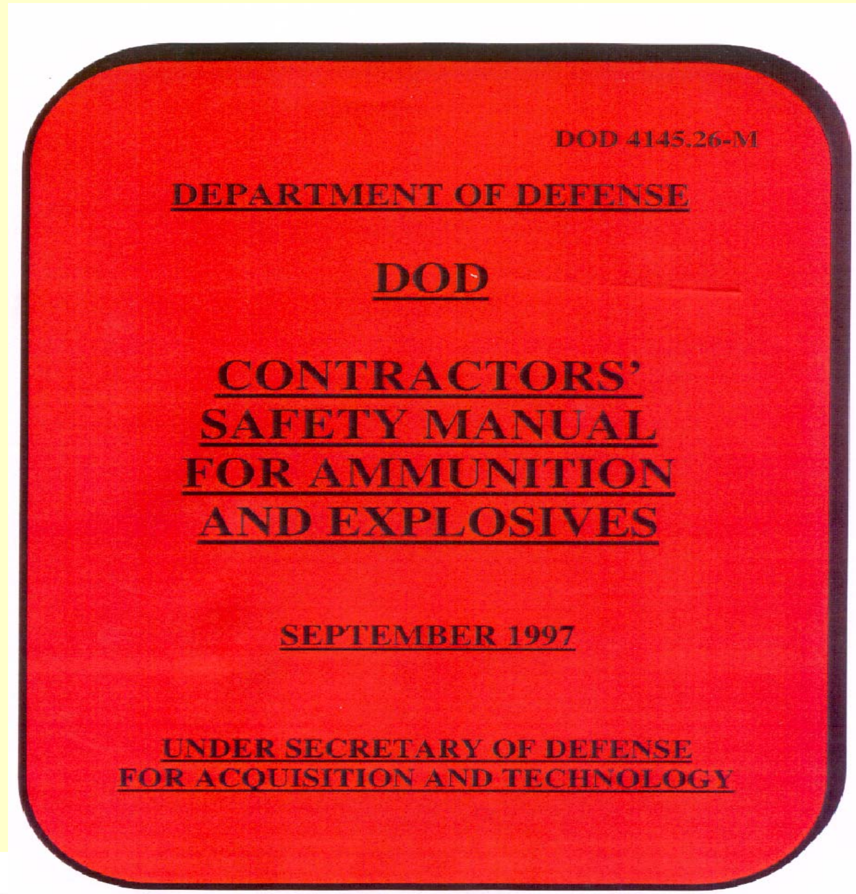
“Flexible” where possible but “Firm” when needed for “Safety’s Sake” - or – “Requirements Dictates”


Cecile D. King
QS
x1486
DOD 4145.26M

DOD CONTRACTORS’
SAFETY MANUAL
for
AMMUNITION, EXPLOSIVES
and
RELATED DANGEROUS MATERIAL

October 1968

DEPARTMENT OF DEFENSE
OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
(INSTALLATIONS & LOGISTICS)


DOD 4145.26-M

DEPARTMENT OF DEFENSE

DOD

CONTRACTORS’
SAFETY MANUAL
FOR AMMUNITION
AND EXPLOSIVES

SEPTEMBER 1997

UNDER SECRETARY OF DEFENSE
FOR ACQUISITION AND TECHNOLOGY

Demil Checking

Safety by Design, However…

“Tritonal and Water”

DoD 4145.26-M - 1997, at C13.2.3. “Properties of Bursting Explosives**.**” States:

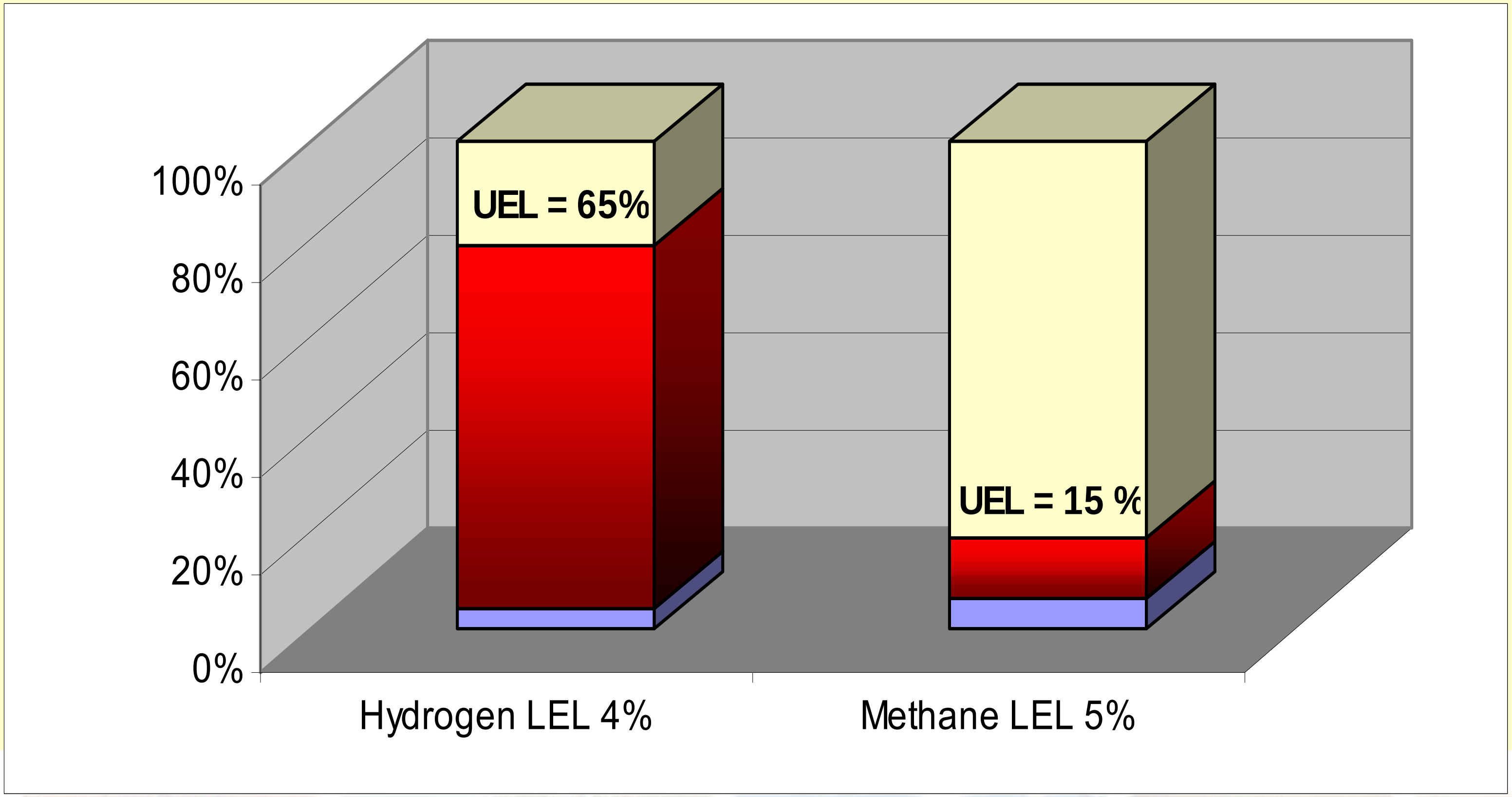
C13.2.3…. Tritonal is a mixture of TNT and aluminum powder and is more sensitive to impact than TNT. ***<u>Tritonal shall not be exposed to water</u>***.

Demil Checking

A Quick Hazard Probability Analysis

Gas Hazards for Maximum Credible Event (MCE)

Considering Lower Explosives Limits (LEL)



Demil Checking

“Flexible” Where Possible

My initial mental M.C.E. led me to the following conclusion- based upon my hazard analysis:

The probability of ignition of hydrogen gas while **safely** sawing bombs in a 7,000 gallon water tank is about as likely as……..

- ❖ Igniting “methane gas bubbles” while lighting a good cigar in a bathtub…

Please “<u>Do not</u> attempt this at home”

Demil Checking

"Flexible" Where Possible

"The Flexible Solution"

- **DCMA – Contracts Safety – Compliance issue**
- **GD-OTS – Safety Management – Review options**
- **EBV – Safety Engineers - Hazard assessment data**
- **GD-OTS – PM & Contracts - Request waiver–"*Flexibility*"**
- **PCO – Safety Office – Reviews data and waiver request**
- **PCO – Grants Waiver – "*Flexibility*"**

Actions

- We focused on finding opportunities
- We used audit findings to identify improvement
- We worked towards making things happen - together with our teammates and customer
- When we found challenges we created opportunities
- Non-conformance and non-compliance were resolved with cooperative efforts and prompt resolution
- Our goals always remained continual improvement
- We know that reports do not make things happen, they should only be used to document results

“Hands On” Safety Results

- More than 43,900 tons / 13.4 Million units demilitarized
- No explosive mishaps, injuries, or facility damages
- No environmental notices of violations
- No health-related injuries or illnesses
- No munition items lost or stolen

GD-OTS Demil Team

QUESTIONS?

2006 GLOBAL DEMILITARIZATION SYMPOSIUM AND EXHIBITION

Update on Demil Technology Programs at General Atomics

By
Jim Elliott
May 3, 2006

Work Sponsors

Defense Ammunition Center, Joint Munitions Command, and Air Force at Tyndall AFB

PRESENTATION TOPICS

- Who is GA & what does GA do?
- GA's Demil Technologies is GA Developing?
- Supercritical Water Oxidation (SCWO)
- Hydrolysis
- FY06 and FY07 Plans
- Summary

GENERAL ATOMICS

LOCATION: San Diego, California

FOUNDED: 1955 by General Dynamics

STATUS: Privately held corporation

OWNERS: Neal and Linden Blue

BUSINESS: High technology research, design, manufacturing, and production for industry and Government in the U.S. and overseas

Very diverse company:
- Nuclear fusion & fuels
- Radar systems
- Unmanned aircraft
- Electronics
- Electromagnetic systems
- Materials development
- Space power systems

WWW.GA.COM

SURVEILLANCE & RECONNAISSANCE

LONG-ENDURANCE TACTICAL SURVEILLANCE AND SUPPORT SYSTEMS

I-GNAT

PREDATOR

PREDATOR B

- **Unmanned Air Vehicles**
- **Command and Control**
- **Defense**
- **Area Surveillance**
- **Scientific Research**

STATE-OF-THE-ART
GROUND CONTROL STATION

GA's DEMILITARIZATION TECHNOLOGIES

Munitions Inspection Systems

Cryofracture and Robotics

Solid Rocket Motor Washout and Hydrolysis

Energetics Incineration

CAD Hydrolysis

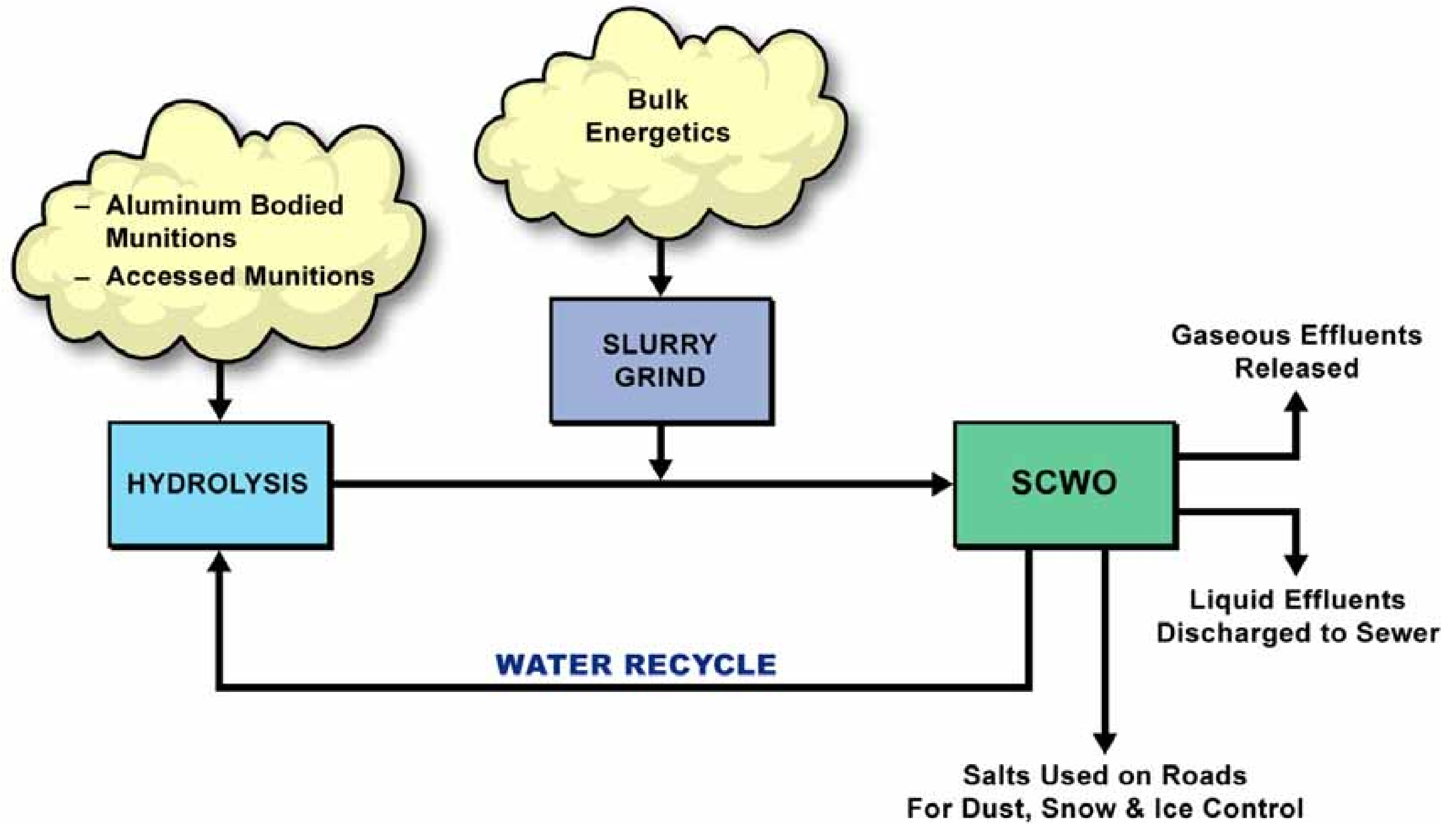
Supercritical Water Oxidation

Dunnage Shredding

Heavy Metals Removal

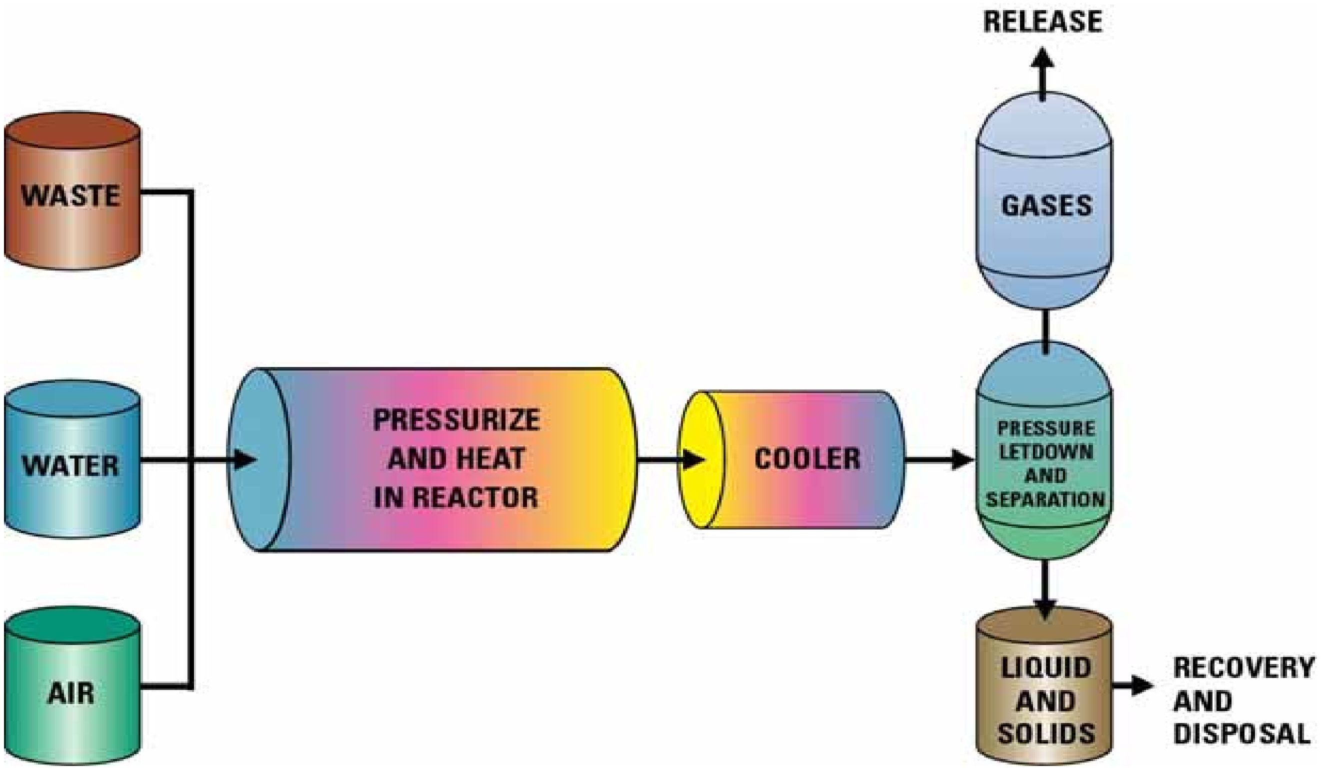
Cryocycle

Demil Processing Equipment



What is Supercritical Water Oxidation (SCWO)?

WHAT IS SCWO?



SCWO is a safe, simple process

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SCWO

- SCWO destroys organics with no production of NO_X, SO_X, dioxins, furans or greenhouse gasses.
- Wastes are mixed with water and oxidized at 3400 psi and 1200F
- Suitable for pumpable organics including slurry mixtures of solid wastes
- Gaseous effluents dischargable to the air
- Liquid effluents dischargable to the sewer

Environmentally friendly waste processing technology

ADVANTAGES OF SCWO

- **SCWO oxidizes organic wastes**
  - **Oxidation of a combustible material at temperatures and pressures above the critical point of water, 374°C and 22.1 MPa (3200 psi)**
  - **Complete oxidation to CO_2, H_2O, and inorganic acids (or salts) for most organic feeds**
  - **No acid gases, dioxins, furans, or particulates discharge**
  - **Minimal Gas Discharge - Low NO_X, SO_X, CO, and TOC**
  - **Destruction of organic wastes occurs very quickly**
- **Process stability**
  - **Fully automated, easy & safe operation**

Ultra clean, environmentally friendly waste processing technology

SCWO DEMIL APPLICATIONS

- **Hydrolysates**
- **Slurried Energetics (explosives and propellants)**
- **Dunnage**
- **Energetics processing waste streams**
- **Hazardous wastes**

Destroys pumpable wastes

M-249(1)
4-16-01

MATERIALS PROCESSED

- **Propellants**
  - CYH, M28, UDMH
- **Explosives**
  - Tetrytol, Tetryl, TNT, Comp B, RDX, HMX, NG, NC
- **Dunnage**
  - Wood pallets
  - Plastic DPE suits, butyl rubber gloves/boots, carbon
- **Hazardous Wastes**
  - VX, GB and HD chemical agent hydrolysates and surrogates
  - Navy wastes, including paints, motor oils, hydraulic fluids, grey water, black water, photographic solutions, TCA, PCTFE, glycol, MoS2
  - Pink water, red water and PCB sludges
- **Other Wastes**
  - Municipal sewage sludges (primary and secondary)
  - Fluorinated organics

M-249(2)
5-8-02

Total test time exceeds 18,000 hours

History of SCWO

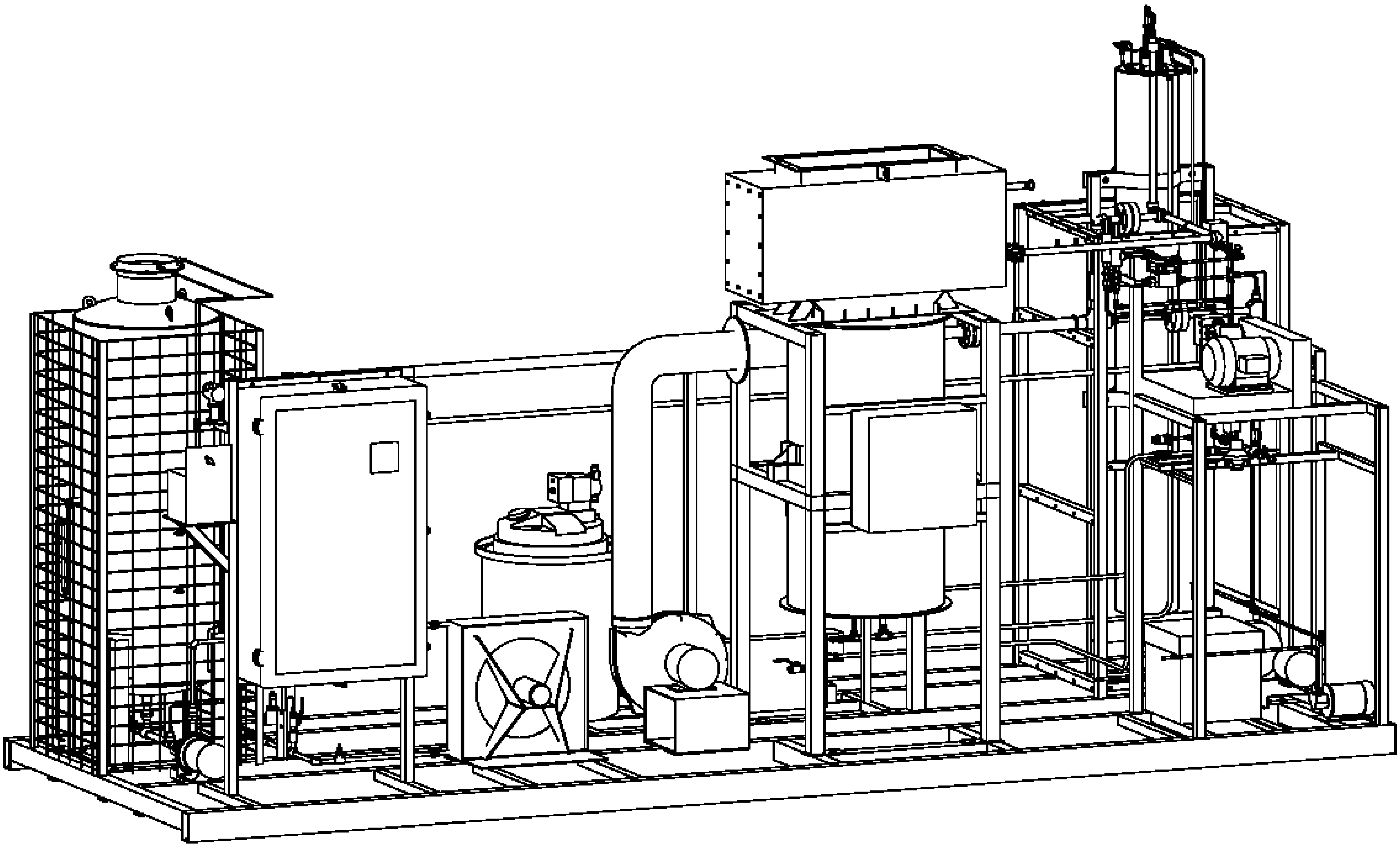
- SCWO technology issues resolved in the 1990's
- Cost & reliability became impediments to operational demil & commercial applications
- iSCWO developed to resolved cost & operational reliability issues
- iSCWOs now penetrating market for selected demil & commercial applications
- 1st iSCWO undergoing operational tests

GA INDUSTRIAL SCWO (i-SCWO)

- **Objectives**
  - Simplified design targeted at specific applications
  - Low capital cost
  - Easy & quick fabrication
  - Robust, reliable & industrial hardened
  - Easy shipment & installation
  - Small foot print
  - Readily permitted
  - Suitable for 7/24 operation
  - Compatible with future energy conversion, HMRS or special feed prep modules
  - Low risk

10 ton/day liquid waste processing unit

Conceptual iSCWO Skid Equipment Layout



iSCWO EQUIPMENT LAYOUT

Hydrolysis

Hydrolysis Production Prototype Plant (HPPP)

Located at Tooele Army Depot

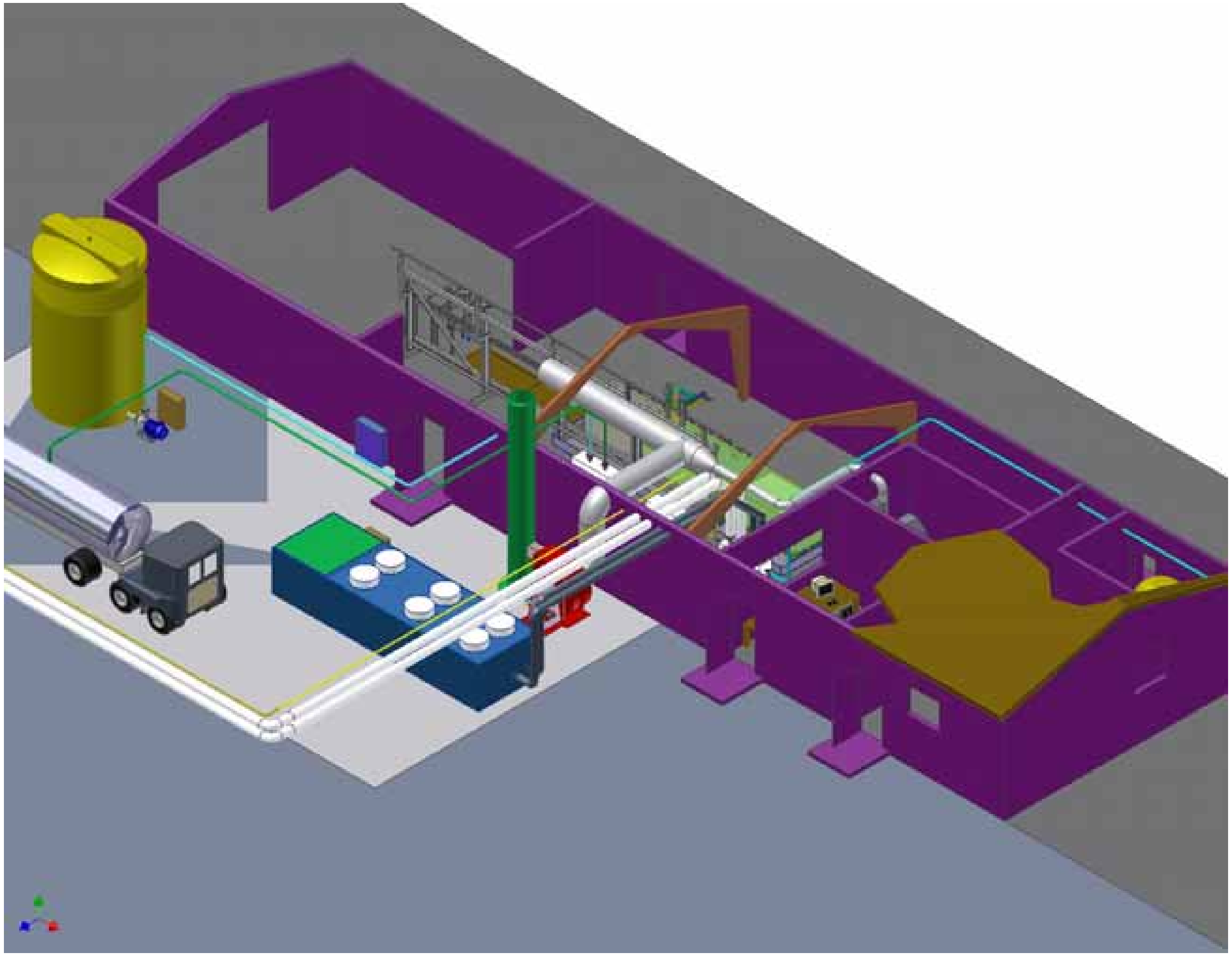
Hydrolysis Production Prototype Plant

Status

- **Designed for demil of aluminum bodied CADs**
- **Design processing rate = ~2 tons/day**
- **Design & construction complete**
- **Checkout & systemization complete**
- **Optimization testing in progress**
- **Permitting in progress**

Over 360,000 CADs Demil'd

CAD HPPP FACILITY



CAD HPPP EQUIPMENT PAD

UTILITY BUILDING EQUIPMENT

Back-up Generator

Steam Boiler

Air Compressor

MAIN HYDROLYSIS LINE EQUIPMENT



MAIN HYDROLYSIS LINE EQUIPMENT

MAIN HYDROLYSIS LINE EQUIPMENT

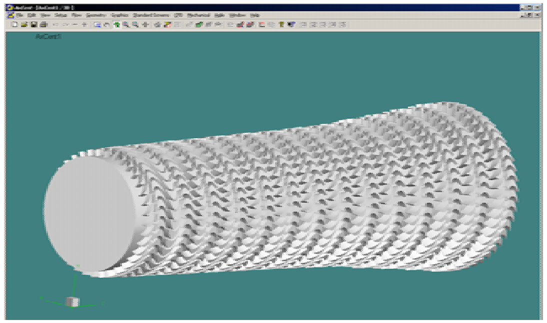
BEAKER TEST AREA AND CONTROL ROOM

FY06 & FY07 Plans

- Support CADs HPPP operations
- Support ROK SCWO shipment, installation & operations
- Design & build iSCWO unit for TEAD
- Design & build iSCWO unit for BGAD
- Continue SCWO energy recovery work
- Continue hydrolysis application engineering

SCWO

Hydrolysis



Energy Recovery

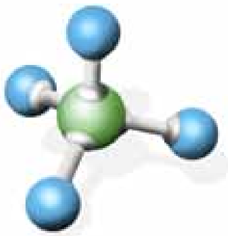
Summary
Demil Technologies Transition Projects

- **Current Technology Transition Projects**
  - ROK SCWO – 1.2 gpm SCWO unit for Korean DEFAC facility
  - TEAD CADs Hydrolysis Facility
  - TEAD 2gpm iSCWO facility
  - BGAD 10 gpm iSCWO

- **Technology Transition Projects Planned**
  - Hydrolysis & Slurry Grind system for BGAD
  - Slurry Grind System for TEAD
  - 10 gpm SCWO for CAAA
  - 10 gpm SCWO & slurry Grind System for LMC
  - Larger iSCWOs & slurry grind systems also being considered for TEAD, Hawthorne and other Ammo plants

2006 Global Demilitarization Symposium & Exhibition

Treatment Technologies for Perchlorate-Containing Effluents



Edward N. Coppola
Applied Research Associates, Inc.
430 West 5th Street, Suite 700
Panama City, FL 32401
(850) 914-3188
ecoppola@ara.com

May 3, 2006

APPLIED RESEARCH ASSOCIATES, INC.
An Employee-Owned Company

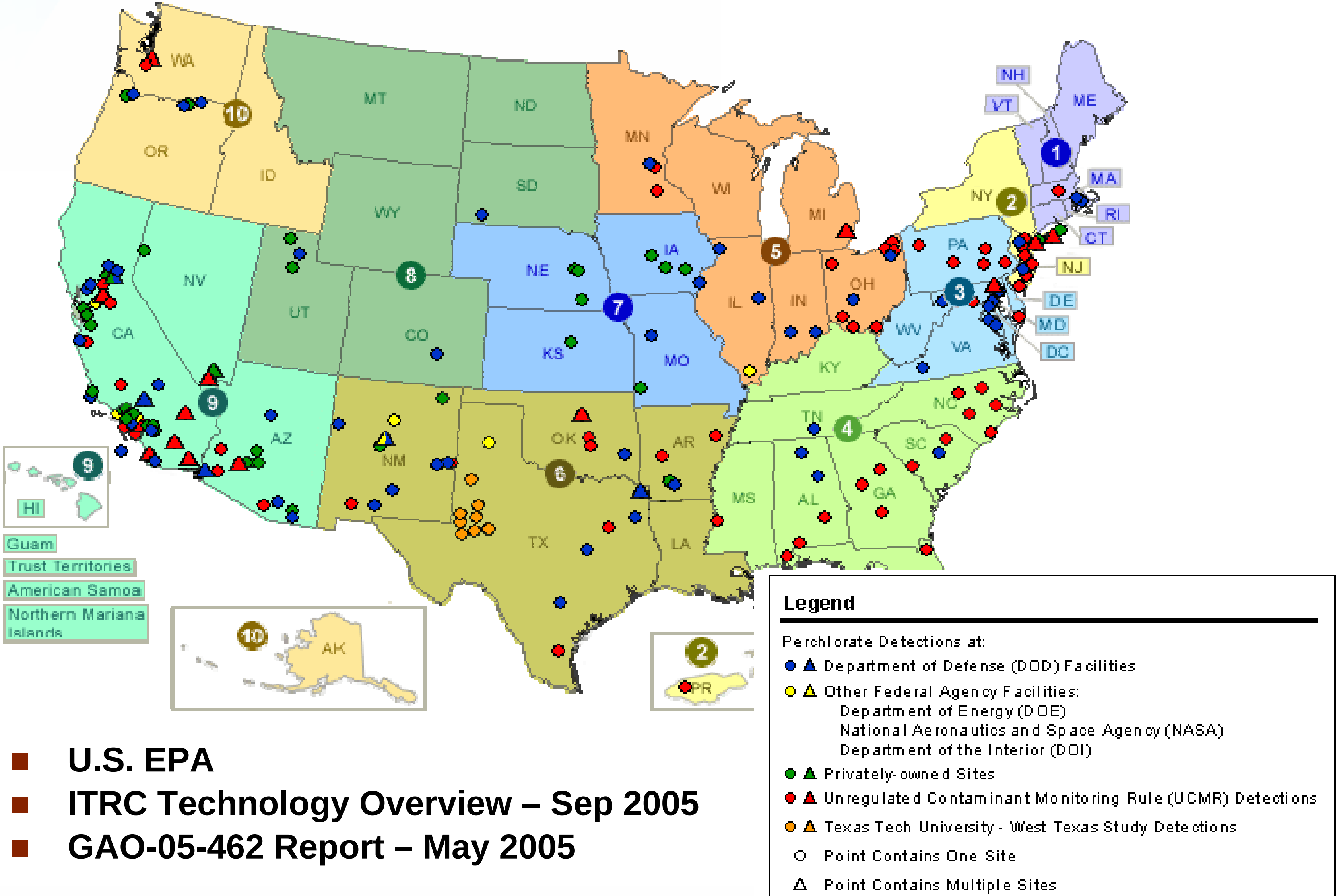
Overview

- Perchlorate Background
- Biodegradation of High-Strength Effluents
  - Commercial wastewater treatment systems
  - Treatment of brine from ion exchange resin regeneration
- Ion Exchange of High-Strength Effluents
  - Non-regenerable, single-use
  - New, regenerable technology

Perchlorate Use

- Oxidizer in Solid Fuel Rockets
  - 12 strategic & 40 tactical motors
- Oxidizer in Explosives and Fireworks
- Ordnance & Insensitive Munitions
  - Over 250 items
- Gunpowder, Flares, Air Bags
- Found as a Contaminant in:
  - Sodium chlorate-based herbicides
  - Fertilizers and nitrates (imported from Chile)
- Naturally Occurring in U.S.

Perchlorate Occurrence



- U.S. EPA
- ITRC Technology Overview – Sep 2005
- GAO-05-462 Report – May 2005

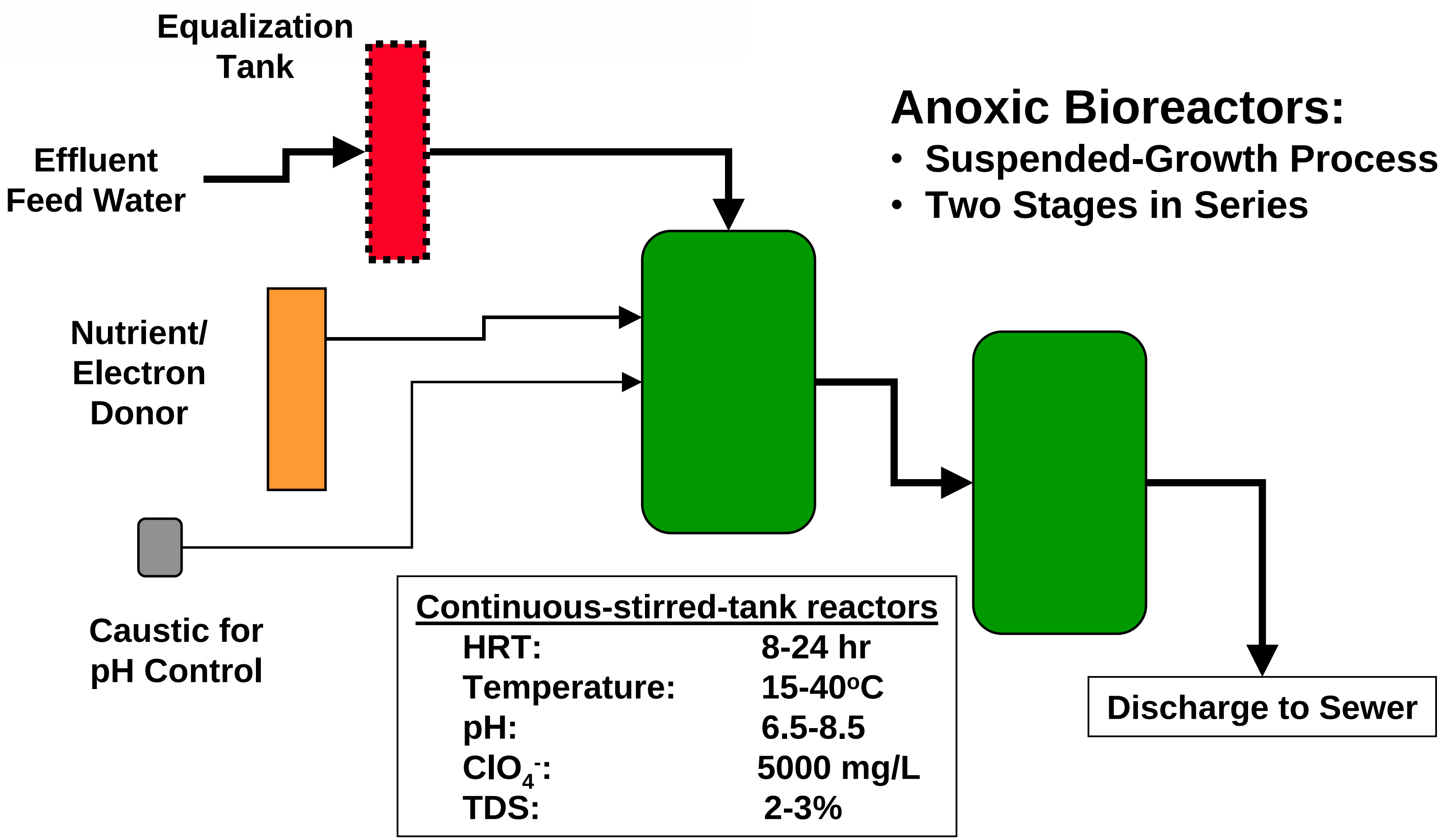
Perchlorate Guidance

- Reference Dose (RfD) Established by EPA
  - January 26, 2006 U.S. EPA Memorandum to Regional Administrators
  - 0.0007 milligram/kilogram-day (mg/kg-day)
  - Drinking Water Equivalent Level: 24.5 parts-per-billion
- DoD Guidance Letter Issued January 26, 2006
  - Established 24 ppb as the " Level of Concern"
  - "DoD will comply with applicable state or federal standards whichever is more stringent"
  - Environmental Quality Status Class I under DoDI 4715.6
- Current State Health-Based Goals – 1 to 14 ppb
- Impact of RfD on Services and Cleanup Goals - TBD

Biodegradation of Perchlorate-Contaminated Wastewater

- Effective for High Concentrations
  - Up to 5000 mg/L or saturated solutions (with dilution)
- Effective for High TDS Effluents
  - From 2-3% salt to over 7% for membrane systems
- Simultaneous Reduction of Co-Contaminants
  - Nitrate, nitrate esters, nitroaromatics, nitramines
  - Heavy metals
- Treated Water can be Discharged to Sewer
- Mature, Robust, Inexpensive Technology
- Demonstrated Track Record

The ARA Biodegradation Process
for Effluents Containing Perchlorate



ARA System at ATK Thiokol

- 1996-97 - Production Prototype
  - AF Research Lab, Tyndall AFB
  - Sponsored by ESTCP & JOCG
- Dec 1997 - Inoculation and Start-up
  - First operational ClO_4^- process
  - Continuous operation thru present
- March 1999 Optimization Project
  - Reduced nutrient costs >90%
  - Desugared molasses
- 2001-2002 – Modification Project
  - Simultaneously treats 3 effluents
  - Up to 8000 lb/month perchlorate

Performance of System at ATK Thiokol

- Treats ~1M Gallons of Wastewater per Year
- Destruction Rates During Last 12 Months
  - Perchlorate: average 1500 lb/mo – maximum 4000 lb/mo
  - Nitrate: average 1500 lb/mo – maximum 6000 lb/mo
- Cost Savings ~$2M per Year
- Effluent Biodegradation is an Enabling Technology for Perchlorate and Rocket Motor Case Recovery and Reuse
  - Minuteman remanufacture – 700, 1st and 2nd stage motors
    - Reused cases valued at ~$2M per set
    - Credit for recovered ammonium perchlorate ~$15K/mo.
  - Space Shuttle RSRM production and case reclamation
  - Delta Strap-on Solid Rocket motor (SSRM) production
- Supports Energetic Material Development and Production
  - CL20, TTB, PAX, decoy flares, nitration processes

2nd Generation Biodegradation System
for Effluents Containing Perchlorate

- Hodgdon Powder Company – Pyrodex Plant
  - Near Herington, Kansas
- Effluent from Gunpowder Manufacturing
  - Perchlorate >3000 mg/L
  - Nitrate >2000 mg/L
- ~3 gpm Treatment Rate
- Inoculated 27 April 03
- Discharge to POTW
  - KDHE Permit <100 ppb
- Additional Effluents
  - Laundry wash water
  - Storm drain water

Wastewater Holding Ponds

Two-Stage Bioreactor

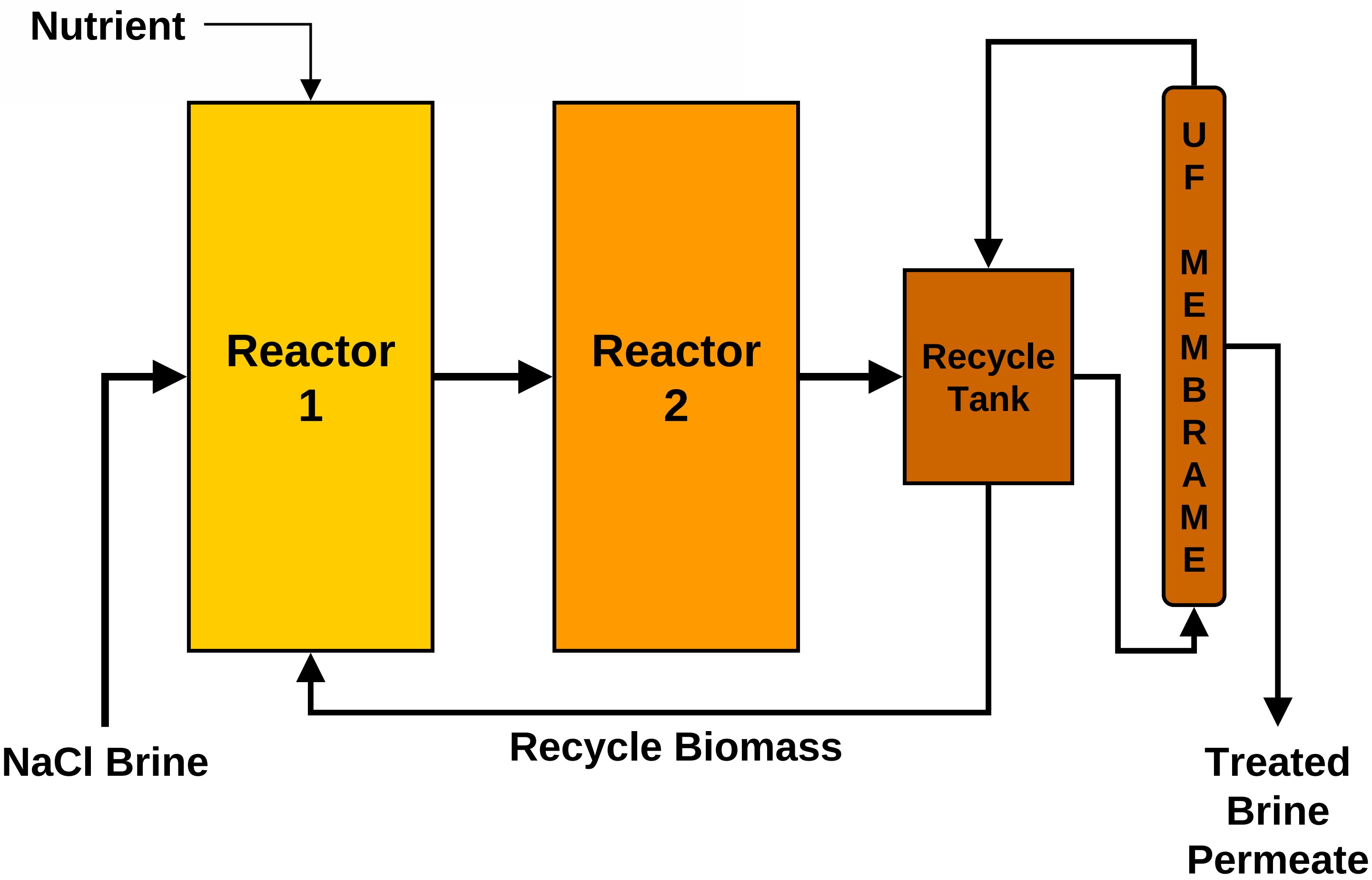
Performance of the Pyrodex Plant

- Over 120 Effluent Tanks Filled, Tested, and Discharged
  - All below discharge limit (100 ppb) and EPA-314 MDL (~20 ppb)
  - Over 2.5 million gallons of wastewater treated
- Kansas Dept. of Health and Environment (KDHE) Reduced Sampling and Analysis Requirement to Every Fourth Tank
- Won Kansas Water Environment Association (KWEA) Award
  - Industrial Wastewater Pretreatment Category
- Lessons Learned
  - Maintain feed under aerobic environment
  - Aerate samples to eliminate false positive IC analyses

Biodegradation of Ion Exchange Brine

- **Regeneration of Strong Base Ion Exchange Resins using Salt (NaCl)**
  - **Generates large quantities of brine effluent (~1% or more)**
  - **Brine effluent is difficult and expensive to treat**
- **High TDS is a Major Challenge for Biodegradation**
  - **Biodegradation at high TDS (6-9%) permits reuse**
  - **Dilution of spent brine to 2-3% TDS facilitates biodegradation but limits reuse potential**
  - **Membrane bioreactor (MBR) process was developed to demonstrate brine treatment and reuse**

Membrane Bioreactor Concept



MBR Field Demonstration System

Pilot Membrane

Pilot Reactors and Membrane

Brine Treatment and Reuse Demo

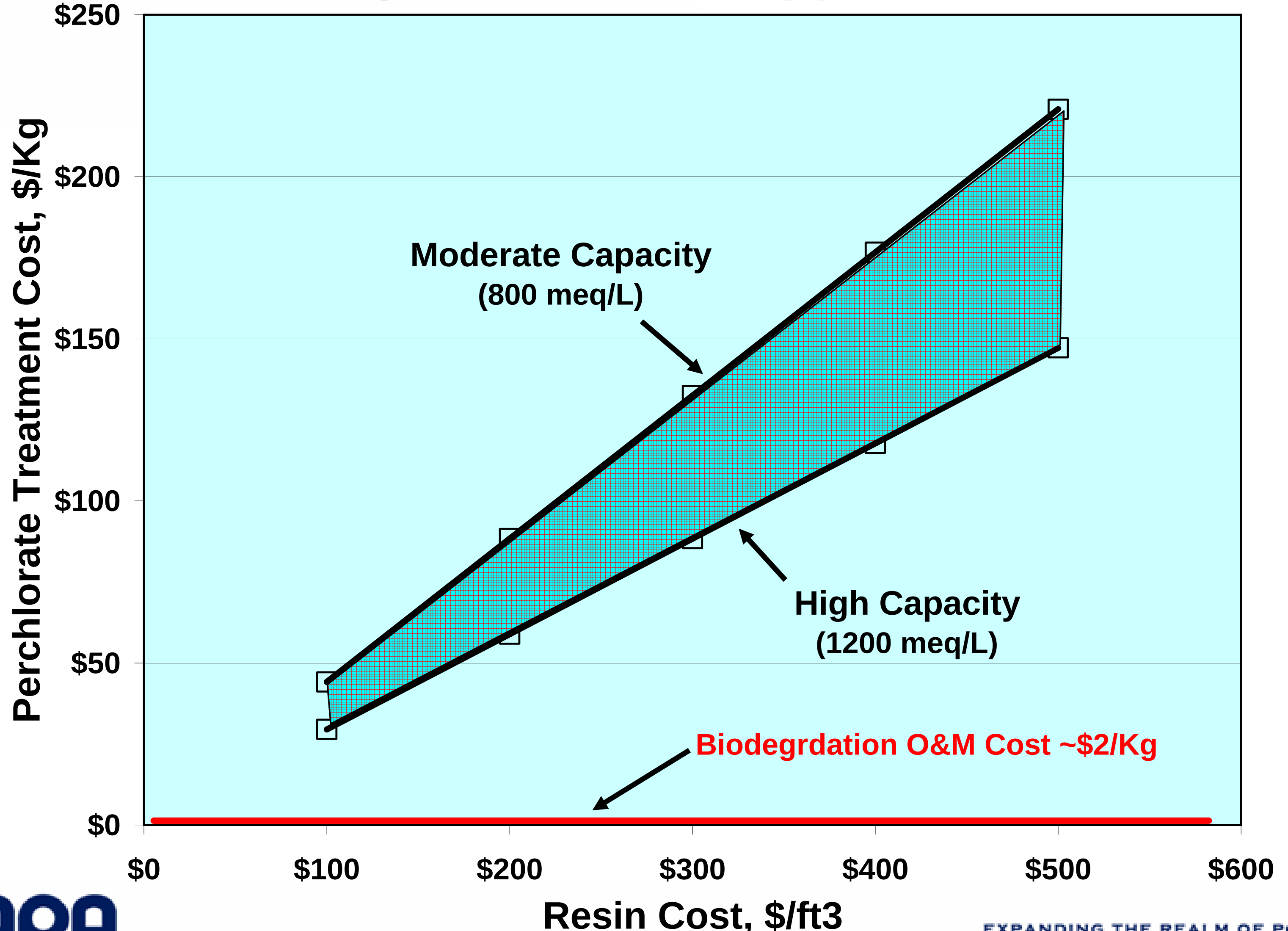
- Real-Time Integrated Demo
- 80% to 90% of Brine was Treated and Reused
- Feed Brine: 6% to 8% TDS
- Two Nutrients Evaluated
  - Acetate and corn syrup
- Complete Nitrate Reduction
- Perchlorate Reduced from ~2500 ppb to < 300 ppb
- Treated Brine was Effective for Regenerating IX Resin
  - No detrimental effects from residual organics
  - No disinfection byproducts

Integrated MBR Brine Treatment and ISEP Ion Exchange Demonstration at Water Utility in Southern California

Ion Exchange for Wastewater Treatment

- Effective for Concentrated Effluents
  - Process wastewater
  - Ion exchange brine, RO rejectate
- Treatment Capacity is a Function of Concentration
  - Performance affected by other anions
  - Most efficient for low flow rate applications
- Single-Use Approach
  - Demonstrated technology
  - Resin and perchlorate destroyed by incineration
  - Expensive – resin replacement and disposal
  - Little or no capital expenditure may be required

Ion Exchange Cost for High Concentration Effluents
Single-Use Resin Approach



ARA

EXPANDING THE REALM OF POSSIBILITY

Regenerable Ion Exchange Technology

- **Brine Regenerable Strong Base Anion (SBA) Resin**
  - **Generates ≥ 1% perchlorate-contaminated salt brine**
- **Ferric Chloride Regenerable SBA Process (ORNL)**
  - **Concentrated HCl and ferric chloride solutions**
- **ARA & The Purolite Company Developed a Weak Base Anion (WBA) Resin Process (Patent Pending)**
  - **Ion exchange & regeneration pH dependent**
  - **Reduces spent regenerating solution to as little as 0.02%**
  - **Effluent is safely handled and easily treated**
    - **Scavenger process for low concentration applications**
    - **Biodegradation for high concentration applications**

Weak Base Anion Resin Chemistry

WBA resin in free-base form ($R\text{-}NH_2$) is ionized ($R\text{-}NH_3^+$) by protonating with acid (H^+):

$$R\text{-}NH_2 + H^+ \rightarrow R\text{-}NH_3^+$$

Protonated resin removes anions (A^-) from aqueous streams:

$$R\text{-}NH_3^+ + A^- \rightarrow R\text{-}NH_3\text{-}A$$

Spent resin ($R\text{-}NH_3\text{-}A$) is regenerated by neutralizing with caustic (NaOH), which liberates anions and returns resin to the free-base form:

$$R\text{-}NH_3\text{-}A + Na^+OH^- \rightarrow R\text{-}NH_2 + HOH + Na^+A^-$$

Pilot Demonstration - Redstone Arsenal

- ESTCP Sponsored
- 6-inch Groundwater Extraction Well
- Perchlorate: 1500–2200 ppb
- Bicarbonate: 150 ppm
- Nitrate: 4 ppm
- Sulfate: 3 ppm
- Chloride: 4 ppm
- TCE: 3100 ppb

Pilot System Design & Operation

- Conventional Lead-Lag Configuration
- Integrated Pre- and Post-Treatment
- 24 hr/day – 7 Day/Week Operation
- 2-inch Diameter Ion Exchange Columns
- Macroporous Polystyrene Divinylbenzene WBA Resin (Purolite D-4170)
  - 36-inch bed depth
- 12 to 24 BV/hr Treatment Rate
  - 1.5 – 3 gpm/ft^3
- Regeneration & Residuals Treatment Conducted Off Site

Benefits of WBA Resin Process

- More Efficient than Brine Regeneration
  - Low volume of effluent
  - "Zero discharge" potential
- Perchlorate-Selective
  - Perchlorate removal to less than method detection limit
  - High capacity compared to brine-regenerable processes
- Effective Wastewater Treatment Process
  - Feasibility tests conducted on several wastewaters
  - Effective from ppb to 1000s of ppm perchlorate
  - Effective in presence of high anion concentration
    - 100s to 1000s of ppm NO_3^-, SO_4^{-2}, and Cl^-
- Low O&M Cost

Drinking Water Demonstration

- **Success of Redstone Demonstration Led to Follow-on Demo Sponsored by ESTCP**
- **Field Test Scheduled to Begin May 2006**
  - **Fontana, California**
  - **Test duration ≥20 weeks**
  - **Multiple, on-site regenerations**
  - **Zero-discharge SBA resin scavenging**
  - **High treatment rate: ≥3 gpm/ft^3**
  - **Obtain data necessary to acquire regulatory approval**

Summary

- **Biodegradation of Perchlorate-Containing Effluents**
  - **Robust, mature – in commercial operation since 1997**
  - **Treatment of co-contaminants has been demonstrated**
    - **Nitrate, nitramines, nitrate esters, nitroaromatics**
    - **Effluents from insensitive munitions production**
  - **Treatment of ion exchange brine has been demonstrated**
- **Ion Exchange for Perchlorate-Containing Effluents**
  - **Single-use processes in commercial operation**
- **Regenerable WBA Resin Technology Improves Economics for High-Concentration Effluents**
- **Optimal Technology Application is Site Specific**

Dynasafe Confined Detonation Chambers - A New Tool for High Production Rate, Environmentally Sound, Low Cost Demil

Global Demil Symposium

Indiana Convention Center

Indianapolis

May 1-4 2006

UXB International

1715 Pratt Dr

Blacksburg, VA 24060

Phone: (540) 443-3746

Presentation Overview

I. Introduction

II. Static Detonation Chambers – general technology description

III. Application to munitions destruction

IV. Operating and performance considerations

V. Conclusion

Introduction

- Typical Challenges of Munitions Destruction
  - Storage & transportation
  - Disassembly of components
    (Fuzes, main charge, boosters, etc.)
  - Irreversible destruction of components
  - Treatment of waste streams
    (Scrap Metal, off-gas, secondary wastes, etc.)
  - Unknowns???

Preferred Approach for Destruction of Munitions

- Absolute minimum disassembly & manual handling
- Off-gas air quality should exceed US and EU air emission standards
- Recovered scrap metal should exceed US 5X standard

Dynasafe Confined Detonation Chambers

- An emerging technology for destruction of munitions (Chemical or conventional), bulk explosives, and explosive contaminated items.
- These chambers are production oriented pieces of process equipment-proven in the field
- Handling of munitions/explosives kept to an absolute minimum for safety and high production
- True 5X scrap results (>1000F and more than 15 min)

Principle of operation

- Heated armored retort (550-600 C, 1000-1100 F)
- Semi-continuous process
  - Munitions fed continuously to retort
  - Explosives in munitions heat up, cook off (pyrolysis)
  - Gasses removed for treatment
  - Scrap remains in retort
    - Feed is stopped and scrap removed when retort full

General description

- Retort (detonation chamber)
  - High temperature stainless steel
  - Double walled for safety
    - Each wall capable of 100% containment
    - Each wall over designed for long life
    - Replaceable if needed
      - None have required replacement to date

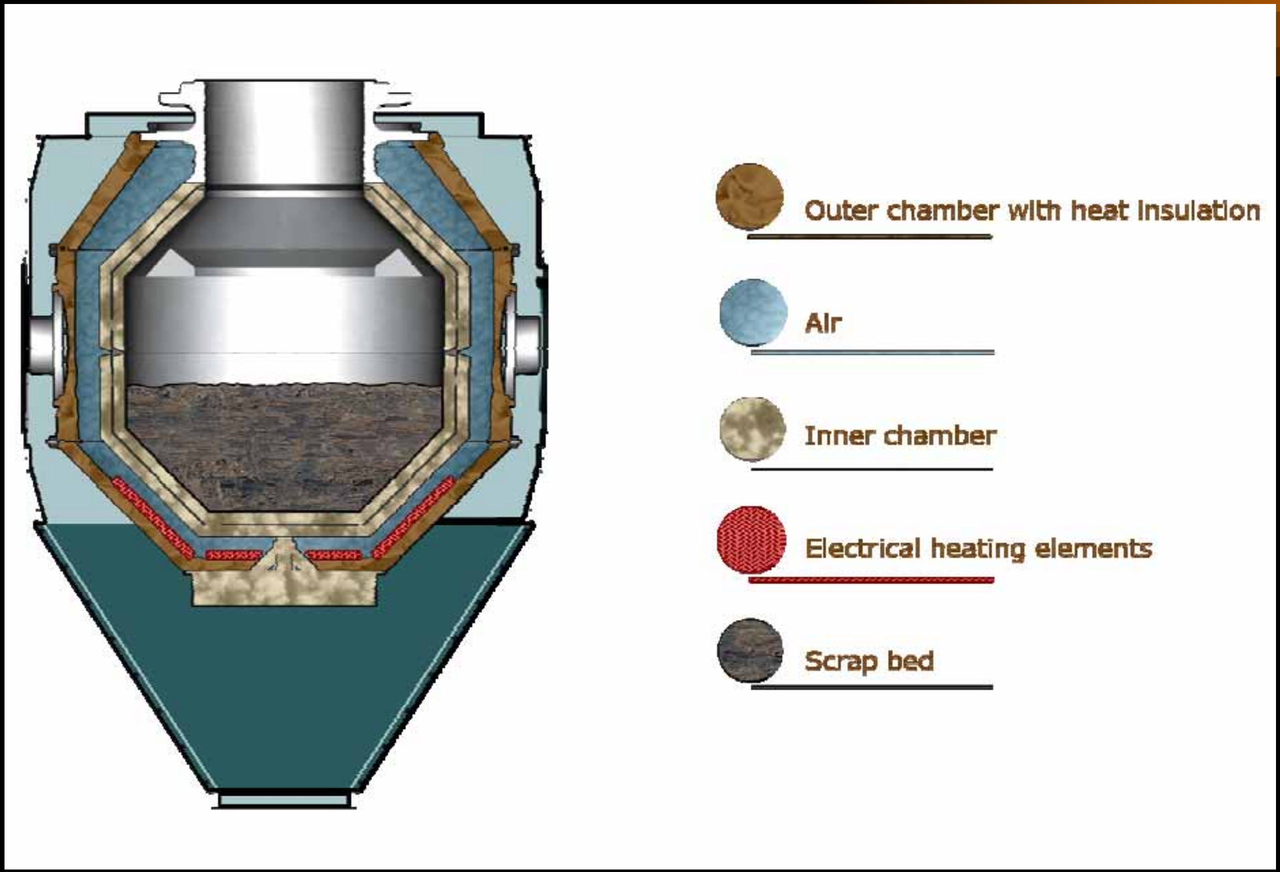
SDC Models

SDC 2000

SDC 1200

Not shown, SDC 800, SDC 400

Cutaway view of Destruction Chamber (SDC 2000)



Feed System

- For all models of SDC
  - Interlocked and sealed blast doors (3)
    - prevent escape of gasses, fragments noise
    - Never allows interior of unit to be open to outside
    - Each can contain full rated detonation
  - Feed chambers (2)
    - Sealed by blast doors
    - Can contain full rated detonation
    - Cooling systems prevent premature initiation

Feed System

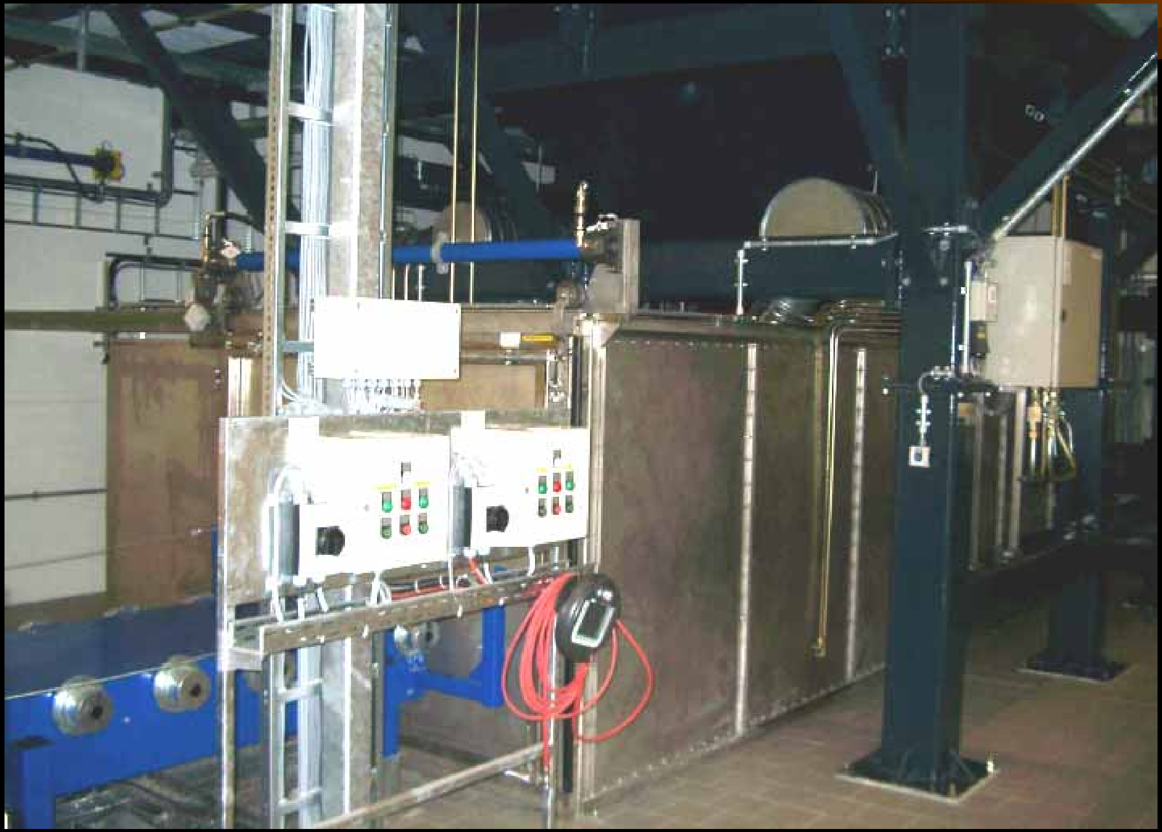
- Completely automatic
  - Computer/PLC controlled
  - Operator can override to stop at any time
  - Remote feeding operation (unattended)
  - Sensors provide stop in case of problems
  - Interlocked with other systems for safety

Feed system SDC 2000

Scrap handling

- When retort is full, feed is stopped and unit uncoupled from feed system after wait period
  - Retort is rotated 180 degrees
  - Scrap is dumped into scrap bins
  - Some scrap is retained to support next cycle
  - Scrap allowed to cool before removal from bins
  - Dust is captured by dust collection system

Scrap Bin Enclosure SDC 2000



Gas treatment system

- Treatment system components for SDCs varies depending on:
  - Size and throughput required
  - Host country emissions limits
  - Anticipated feed (Chlorine, heavy metals, WP)

Minimum gas treatment components

- Equalization tanks
- Secondary combustor
- Quench
- Scrubber(s)
- ID fan
- Stack

Gas treatment system SDC 2000

On line instrumentation for emissions control

- Temperature
- Moisture
- O_2
- Dust
- HCL/HF
- SOx
- NOx
- CO/CO_2
- TOC
- Flow

Control System

SDC Installations Worldwide

- **Bofors LIAB AB, Sweden.** SDC400, delivered in 1997 for destruction of detonators for anti personal mines.
- **FAEX, Spain.** SDC1200, delivered in 1997 used for destruction of large amounts of different munitions
- **Swedish Defense Material Administration, FMV, Sweden.** SDC800, delivered in January 1999.
- **Sumitomo Corporation Europe Plc, UK for Hokkaido NOF Corporation, Japan.** SDC1200, was delivered in May, 2000.
- **Technip/Germany - IDD/Portugal.** SDC1200, delivered in November, 2000.
- **NKK/Japan.** SDC1200, for project "Destruction of abandoned chemical weapons".
- **UXB International, USA:** SDC1200 for destruction of munitions, 2002
- **UXB International, USA:** SDC2000 is in operation for all type of munitions, 2003.
- **GEKA Munster, Germany:** SDC2000 for the destruction of old chemical munitions, 2005.

Actual Production rate experience

Sl. No.	DESCRIPTION OF REJECTED AMMUNITION/ EXPLOSIVE	ACTUAL QUANTITY DESTROYED	DEMIL PROCESS	ACTUAL SHIFTS REQUIRED	CALCULATED PLANT CAPACITY UNITS /SHIFT (10-HOUR SHIFT)
1	Cap Precussion	74,175	DIRECT FEED	0.1	741750
2	Booster Cup	26,900	DIRECT FEED	2.7	9963
3	Detonator	16,415	DIRECT FEED	2.1	7817
4	Cartg. 20mm HE	54,496	DIRECT FEED	7	7785
5	Cartg. 30mm HE	30,005	DIRECT FEED	5.5	5455
6	30mm HE	7,154	DIRECT FEED	1.8	3974
7	Cord Detonating, Meters	200	DIRECT FEED	0.1	2000
8	Cartg. 40mm	19,809	DIRECT FEED	10	1981
9	Electric Fuze	180	DIRECT FEED	0.1	1800
10	Mine M-3 (A/P)	2,316	DIRECT FEED	1.5	1544
11	Hand Grenade MK-2	3,952	DIRECT FEED	3	1317
12	Mine M-14	2,731	DIRECT FEED	3.5	780
13	Flare Trip Wire	1,200	DIRECT FEED	2.5	480
14	Mortar, 60 HE	1,995	DIRECT FEED	4.5	443
15	Cartg. 57mm Recoilless	4,795	DIRECT FEED	11.8	406
16	Cartg. 75mm Recoilless	32,149	DIRECT FEED	95	338
17	Cartg. 105mm HE	5,647	CUT / FEED	18.5	305
18	Mortar, 81 HE	293	DIRECT FEED	1	293
19	Cartg. 106mm Recoilless HEAT	18,948	CUT / FEED	65	292
20	FUZED MINE AT 1B ND	14,106	CUT / FEED	50	282
21	Mine M-2 (A/T)	924	DIRECT FEED	3.5	264
22	Rifle Grenade 73 mm HEAT	9,147	CUT / FEED	35	261
23	68mm Rocket Warhead	741	DIRECT FEED	2.9	256
24	Mortar, 4.2" HE	1,654	CUT / FEED	7.5	221
25	Cartg. 100mm HE	871	CUT / FEED	4	218
26	Cartg. 76mm HE	90	CUT / FEED	0.5	180
27	Proj. 75mm WP	5,145	DIRECT FEED	35	147
28	Mortar 60 WP	825	DIRECT FEED	7	118
29	Proj. 155 HE	874	CUT / FEED	9.2	95
30	Mortar 81 WP	276	DIRECT FEED	4	69
31	Mortar 81 Illum.	475	DIRECT FEED	7	68
32	Proj. 105 WP	1,291	DIRECT FEED	22	59
33	Proj. 155 Illum.	1,305	DIRECT FEED	26	50
34	Mortar 4.2" WP	841	DIRECT FEED	19	44
35	Proj. 155 WP	990	DIRECT FEED	65	15

Production Demil

- Most munitions deflagrate rather than detonate
  - Fewer and lower velocity fragments
- Some munition types always detonate
- Fuzed munitions usually detonate

SDC chamber wear over time

- SDC design has large wear allowance built in
- Retained scrap bed absorbs much of explosion energy
- Variable scrap bed level distributes wear over inside of chamber
  - Eliminates high wear areas
- Measurements to date show no to very little wear even after 2,000,000 lbs munitions processed
- No SDC chamber has ever needed replacement

Inside of chamber after ~2,000,000 lbs munitions processed

- Very little wear

Maintenance requirements

- Low maintenance.
  – SDC unit requires occasional gasket or sensor replacement
  – Gas treatment system requires sensors and pump seals
    - Gas treatment system more maintenance intensive if WP is being processed
- 84% availability experience (UXB)

Scrap is at a 5X condition

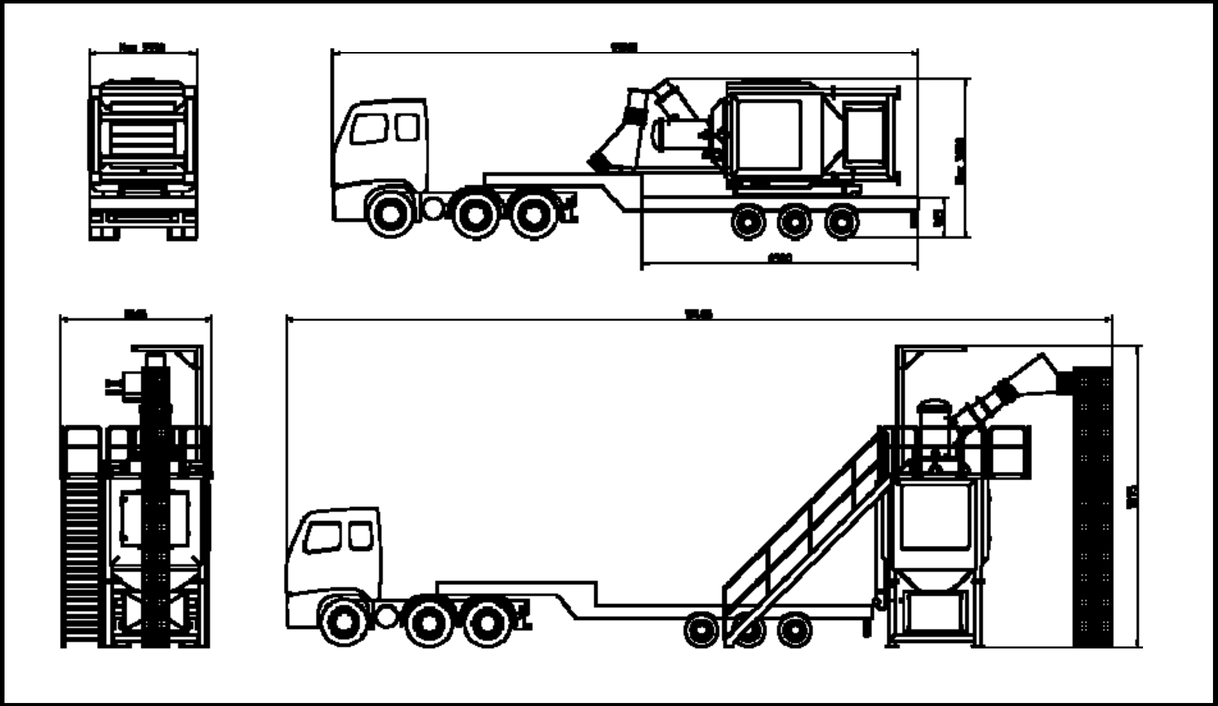
Latest SDC Installation

- SDC 2000 in Munster Germany
  - Designed for recovered chemical munitions (WWI and WWII)
  - Has completed commissioning and plant turnover to client (GEKA)
  - Over 1000 chemical rounds processed as of 06 April 2006 with no problems
  - Open for tours, CWD 2006 Conference, 15-18 May 2006, LÜNEBURG, GERMANY

GEKA Installation

New design for Mobile unit

- Based on SDC 1200
- Truck mounted
- Can be configured for Chemical Ops



Conclusions

- Static Detonation Chamber is a production oriented piece of process equipment
  - Low maintenance, long life, economical
  - Little to no munitions preparation
  - True 5X scrap from process
  - Meets emissions requirements

Energetic Materials

Testing Instruments ✧ Technologies ✧ Expert Services

KVG-16 INDUSTRIAL DETONATION CHAMBER FOR DISPOSAL OF PYROTECHNIC MUNITIONS

Dr. Marcel Hanus, Dr. Miloslav Krupka

14th Global Demilitarization Symposium, Indianapolis, 1 – 4 May 2006



OZM Research, Nadrazni 266, 538 62 Hrochuv Tynec, Czech Republic
Tel: +420 608 746 932, Fax: +420 469 692 882, E-mail: hanus@ozm.cz, http://www.ozm.cz

INDUSTRIAL DETONATION CHAMBERS

- Automated remote-controlled **machinery designed to withstand repeated detonations** (up to 16 kg TNT) **as part of a manufacturing process**

- Heavy steel structural parts capable to **absorb and dissipate detonation** shock wave, explosion heat and accelerated fragments and to **steadily release** stabilized post-explosion **gases** to the **off-gas treatment**

- **Manufactured since 1960s** by Design and Technology Branch of Lavrentyev Institute of Hydrodynamics, Russian Academy of Sciences - Siberian Division, Novosibirsk

- **Industrially applied** for explosive forming of metals (hardening, welding, pressing, cutting) **in continuous operation mode** with short working cycle



EXPERIENCED FEATURES

- **High operational safety**
  - Multiple independent blocking mechanisms against premature firing
  - Programmed control panel controlling the proper working sequence
  - Operated from a separate room
  - Very low noise and vibration emissions even inside buildings
  - All contacts of operators with moving parts, high voltage or pressurized fluids eliminated.
  - Excellent safety record in more than 40 years of industrial use

- **Excellent service life** (10^4 - 10^5 detonations)

- **Low investment costs** ($100,000s)
- **Low operating costs** (very limited maintenance or repairs)
- **Cost-effective off-gas treatment** due to minimum volume of concentrated and cold post-explosion gases for treatment

- **Short working cycle – high productivity**

PARTNERSHIP IN INDUSTRIAL DETONATION CHAMBERS

- **Design and Technology Branch of Lavrentyev Institute of Hydrodynamics, Russian Academy of Sciences - Siberian Division, Novosibirsk**
  - **Manufacturing** industrial detonation chambers for >40 years
  - Leading Russian **scientific base** for confined explosion effects, high-pressure physics, hydrodynamics, explosive metal-forming
  - Bodies of the detonation chambers and their hydraulic cylinders

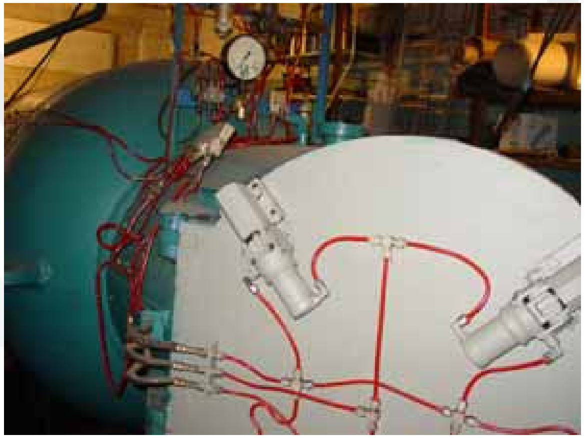
- **OZM Research, Czech Republic**
  - Czech leading manufacturer of **testing instruments for explosives**
  - Supply of **EU-certified hydraulic and electrical systems** for the detonation chambers
  - **Programmable control panel** with firing circuit
  - **CE marking** according to EU regulations
  - **Know-how** for environmentally safe ammunition disposal
  - **Marketing and sale** of the detonation chambers outside Russia

TYPES OF DETONATION CHAMBERS

- VERTICAL
  - KV-0.2 (0.2 kg TNT)
  - KV-2 (2 kg TNT)
  - KV-5 (5 kg TNT)

- HORIZONTAL
  - RADUGA (2.6 kg TNT)
  - KVG-8 (8 kg TNT)
  - KVG-16 (16 kg TNT)

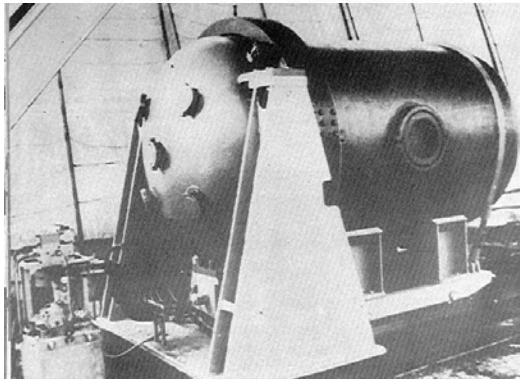
- SPECIAL PURPOSE
  - BP-2 (2 kg TNT)
  - ALFA-2 (2 kg TNT)
  - ALFA-7 (7 kg TNT)
  - R&D Lab Types
    - (0.1 – 2 kg TNT)



KV-2 FOR AMMUNITION DISPOSAL

- Experience with application of **three KV-2 (2 kg TNT) vertical chambers** for ammunition disposal in the Czech Republic
  - First KV-2 operated by VTUVM Slavicin **since 2002**
  - Second KV-2 installed there in **3/2006** for parallel use
  - Third KV-2 to be installed in Zeveta Ammunition Bojkovice in **6/2006**
- **Disposal of non-recyclable ammunition elements**
  - Detonators (2,000 – 5,000 a shot)
  - Primers (500 – 2,000 a shot)
  - Mid.cal.fuzes (100 – 500 a shot)
  - Artillery fuzes (50 – 100 a shot)
  - Mid.cal.projectiles (50 – 200 a shot)
  - Bulk explosives, propellants and pyrotechnics (2 kg TNT)
- **1 operator** for a shift, working cycle: **20 min**
- **4-step off-gas treatment**
  - cyclone, particle filter, alkaline scrubber, adsorbers
  - >99.999 % Pb/Sb, 99.99 % Hg and solids, 99 % SO_2

HORIZONTAL DETONATION CHAMBERS



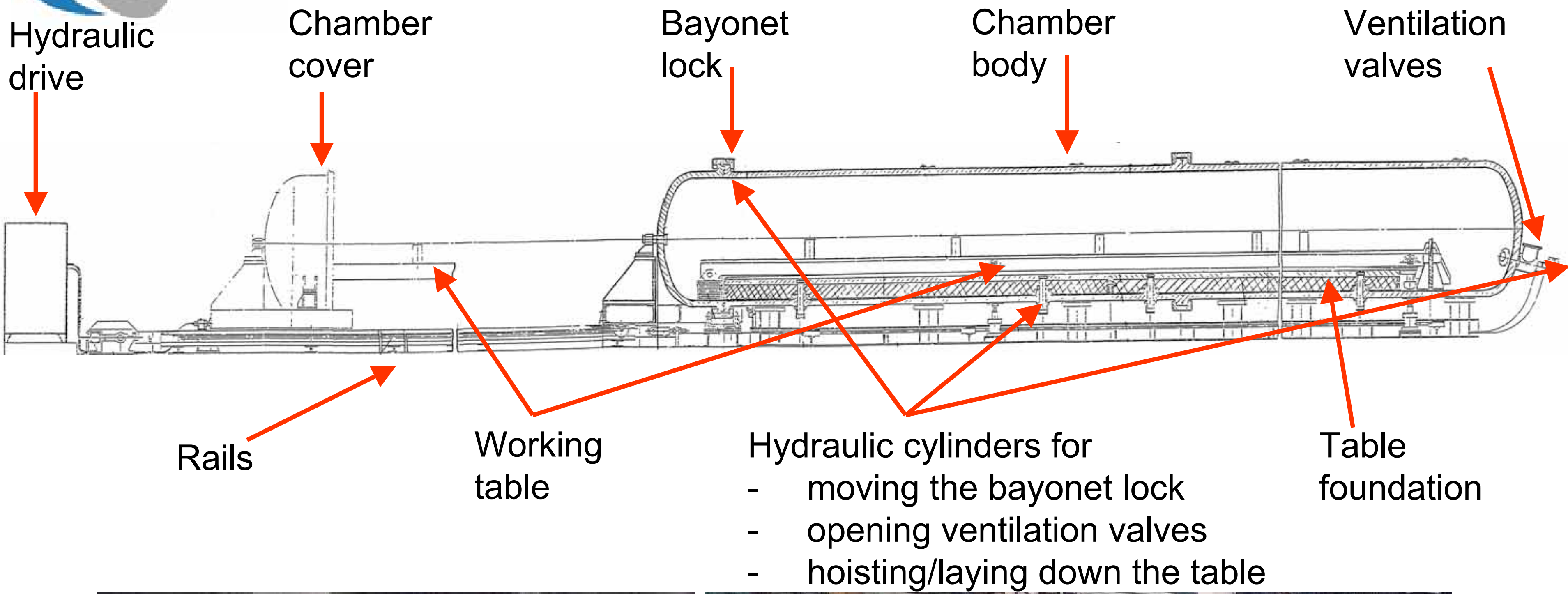
RADUGA

KVG-8

KVG-16

Type	RADUGA	KVG-8	KVG-16
Max. charge weight	2.6 kg TNT	8 kg TNT	16 kg TNT
Max. linear charge weight	1.3 kg/m TNT	2 kg/m TNT	2 kg/m TNT
Working table dimen. [mm]	2000 x 800	4000 x 800	8000 x 800
Inside diameter [mm]	1600	1600	1600
Overall dimen. L/W/H [mm]	5300/2800/2600	16360/2200/2400	27210/2200/2460
Total weight [tons]	20.5	48	76

KVG-16 DETONATION CHAMBER



NEW TASK – PYROTECHNICS DISPOSAL

- In connection with the **Czech Army ammunition demilitarization program** (70 kT)
- Modification of KVG-16 for destruction of pyrotechnic munitions (**„K-16“ chamber**)
- Operated by **ZEVETA Ammunition Bojkovice**, CZ
- **Imitation cartridges** (artillery-fire simulants) – white flash, red flash
  - $KClO_3$/Mg or $KClO_3$/Mg/$Sr(NO_3)_2$/PVC flash powders in plastic cartridges
  - 16 kg of flash powder each shot
  - > 300 net tons of ammunition in total
  - > 200 net tons of flash powders
  - To be disposed in < 2 years
- **Off-gas treatment** for trapping solid particles
  - MgO, KCl, SrO, pieces of plastic (PS) body
  - **Solidification procedure** for waste landfilling
- Installation started: **April 2005**
- Permitted full-scale operation: **September 2005**

KVG-16 CAPACITY

- **8-metre long explosive charge** from the imitation cartridges connected by 2 lines of detonating cord and initiated by electric detonator

- **White flash** (without Sr) and **red flash** (with Sr) cartridges with **16 kg flash powders** in one charge for homogeneous composition of the resulting ashes
  - 21 pieces of V-100 size (750 g ea)
  - 64 pieces of V-30 size (250 g ea)
  - 320 pieces of V-5 size (50 g ea)



- **20 shots** per day (2 shifts) **nominal capacity** (to be increased)

- More than **3,000 shots** fired so far (April 2006) without incident/accident
  - About 12,000 shots still to be fired for finishing the program (by end of 2007)

- Maintenance and repair **costs negligible** so far

KVG-16 OPERATION SAFETY

- **PLC control panel**
- **Commands**
  - Firing circuit, siren
  - Hydraulic unit/cylinders/drive
  - Ventilating fan, compressor
  - Particle filter
  - 3 CCD cameras
- **Controls**
  - 20 proximity limit switches
  - Signals, entries
  - Electrical equipment
  - Proper execution of the sequence
- **Ensures high operational safety**
  - Multiple independent blocking mechanisms against premature firing before full completion of the working sequence or in presence of persons in working area
  - Eliminates all contacts of personnel with moving parts, high voltage or pressurized fluids during preparation of an explosive charge
  - Locks against unauthorized operations and firing

KVG-16 POLLUTION CONTROL

- **High performance particle filter Herding**
  - 3600 $m^3.h^{-1}$ nominal air flow
  - Particle emissions: **0.33 $mg.m^{-3}$**; **1.2 $g.h^{-1}$**
    - **600 times lower than emission limits**
  - Automatic dust flick-off by compressed air
  - **Air compressor** with air drier and filters
  - **Two parallel pipelines** switched by pneu valve
    - Exhaust from chamber ventilation valves
    - „Vacuum cleaner“ line with cyclone for ashes
- **Waste processing (outsourced)**
  - Only **non-toxic ashes** produced
    - 73 % MgO + 26.5 % KCl + 0.4 % SrO + 0.1 % $MgCl_2$
    - Fragments of polystyrene bodies
  - **Solidification** with cements and polymers to blocks
  - **Land-filling** as non-dangerous non-leaching waste
- **Noise issue**
  - Noise level in the hall during **charge preparation**: 65 dB (average)
  - Noise level in the control room **during detonation**: 54 dB (average)

KVG-16 VIDEO

THANK YOU FOR YOUR ATTENTION!

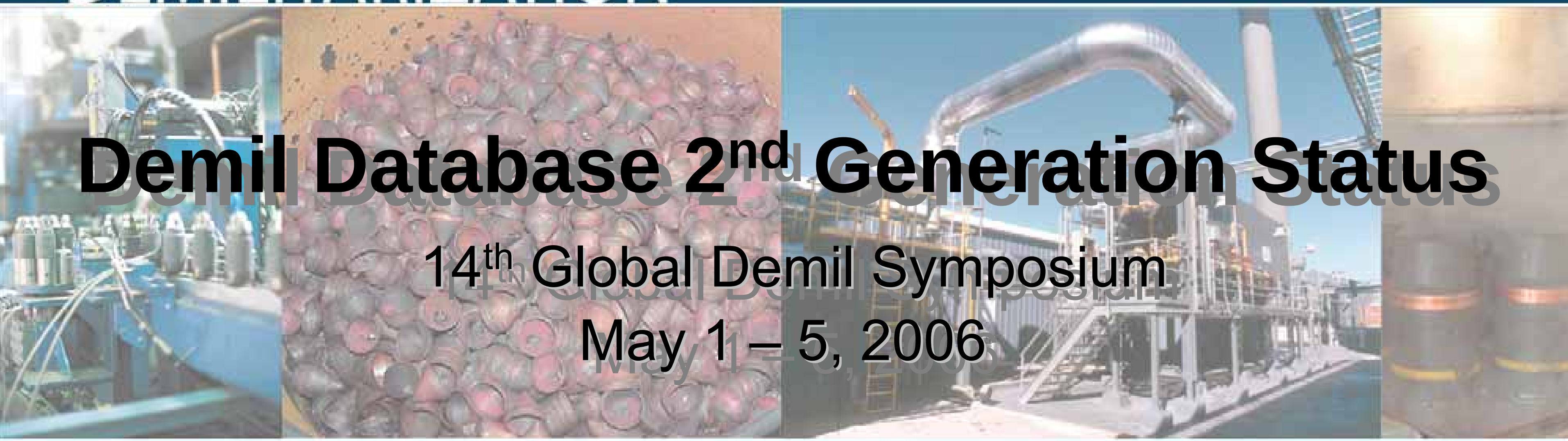
GENERAL DYNAMICS

Ordnance and Tactical Systems

14th Global Demil Symposium

May 1 – 5, 2006

DEMILITARIZATION



Demil Database 2nd Generation Status

14th Global Demil Symposium

May 1 – 5, 2006

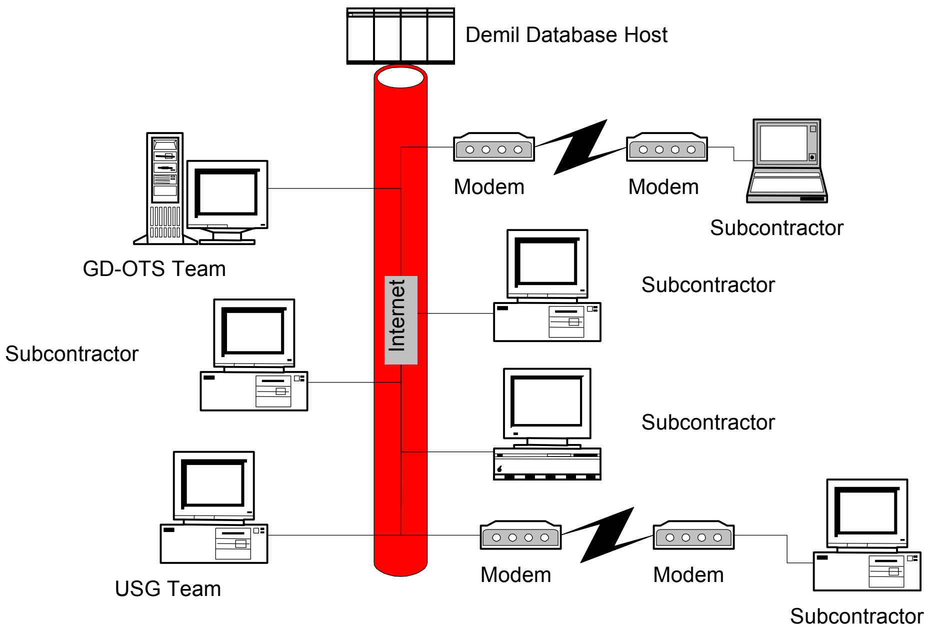
Robert Sontheimer
Demil Program Planner
727-578-8318
rrsontheimer@gd-ots.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

R3 DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

Existing GD-OTS DEMIL Database

- A single database to store the inventory and production data
- Maintains accountability of GFM assets
- Internet based – accessible worldwide
- Real time access
- Database Manager
- Multi-level security: DB Users are given a PIN which gives them access privileges
- One source of numbers
- Historical data repository



The System Maintains Real-Time Status and Location of the Demil GFM Assets

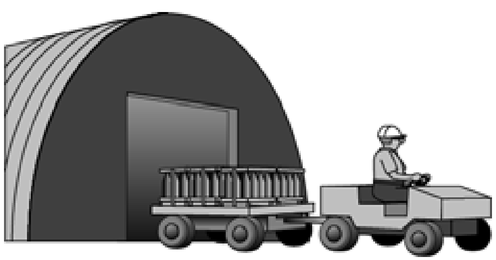
Current Database Functions and Capabilities

- **Powerful Communication Tool between GD-OTS, our Customers, and our Demil Subcontractors**
- **Provides “Cradle-to-Grave” Accountability of the Demil GFM Assets**
  - **Contract requirements**
  - **Depot assignments**
  - **Material Release Orders (MRO) issued to the depots**
  - **Material receipt at the demil subcontractors**
  - **Demilitarizarition processing**
  - **Certificate of Destruction (COD)**
  - **Contract delivery**

GD-OTS Subcontractor – Inventory Control

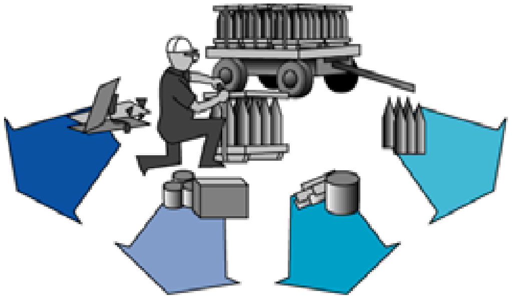
- **The GD-OTS Online inventory database system controls the movement, storage, and processing of GFM Assets**
- **Data entry is controlled with drop-down menus**

Control and monitor storage and movement



Demil 2000 Database

Monitor processing



Cradle to Grave – Storage to Recycle

Current Database Reporting Functions and Capabilities

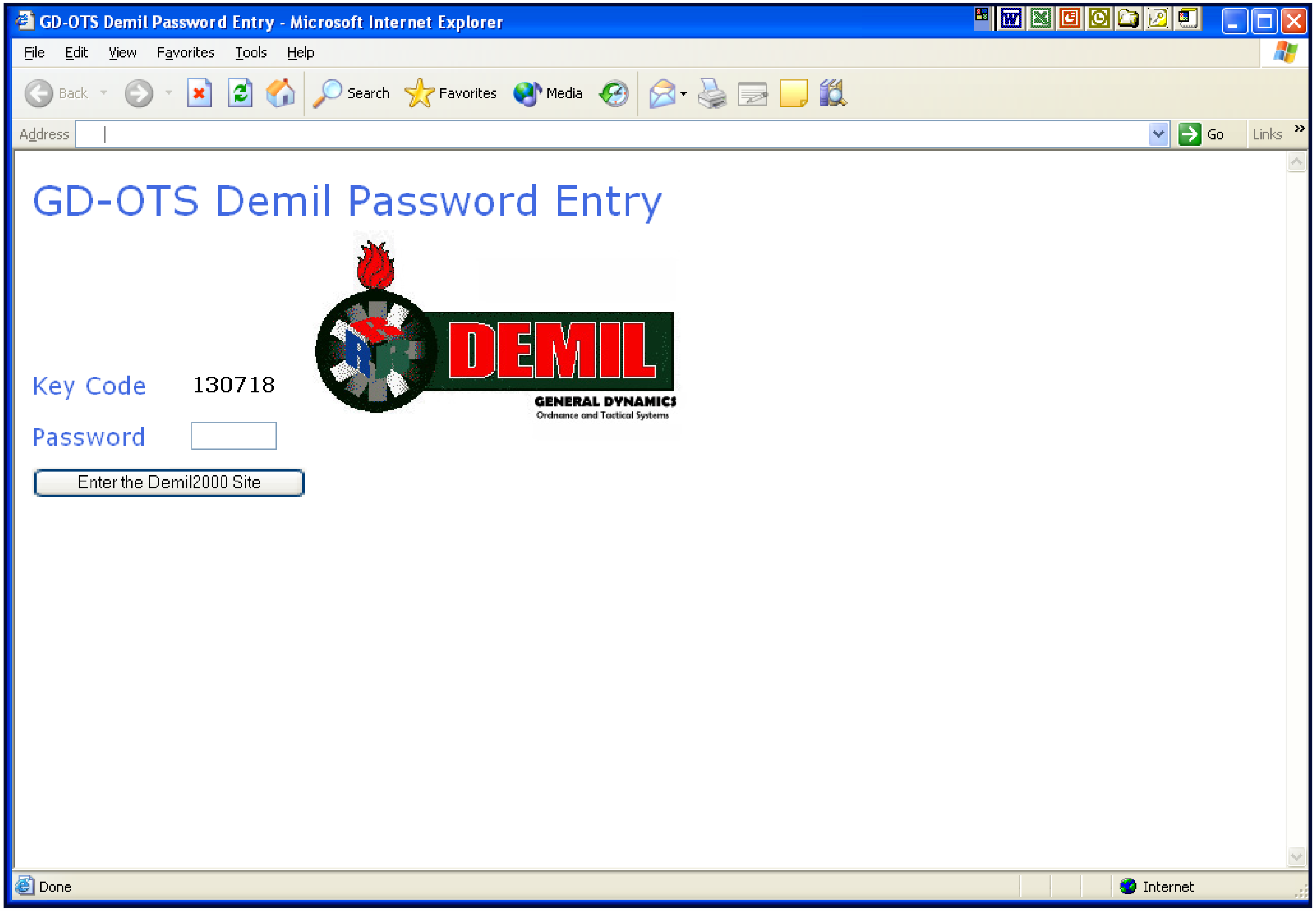
- **Generates reports**
  - **Automated reports (Inventory, Requirements, Delivery Status, COD, ROD)**
  - **Download reports into Excel**
- **Calculates Demil processing data**
  - **Total Demil units processed**
  - **Total Demil tons processed**
  - **Resource Recovery and Recycle (R^3) percentage**
  - **Pyrotechnics, Explosives, and Propellants (PEP) tons**

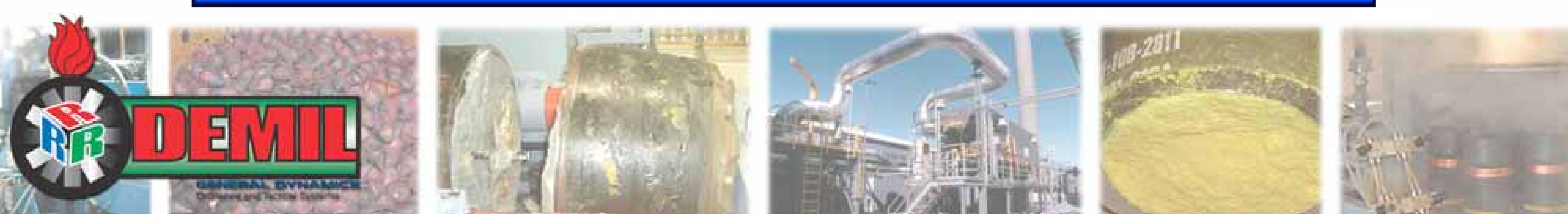
GD-OTS Demil Database Provides Real-Time Tracking Information

Planned Second Generation Enhancements

- **Incorporate an Integrated Data Environment (IDE)**
  - **Document notice and repository**
  - **Calendar**
  - **Bulletin Board**
- **Establish automated e-mail alerts and task assignments**
- **Introduce a workflow approval process**
- **Improve and upgrade the report generation process**

Planned Access To Database and IDE Home Page

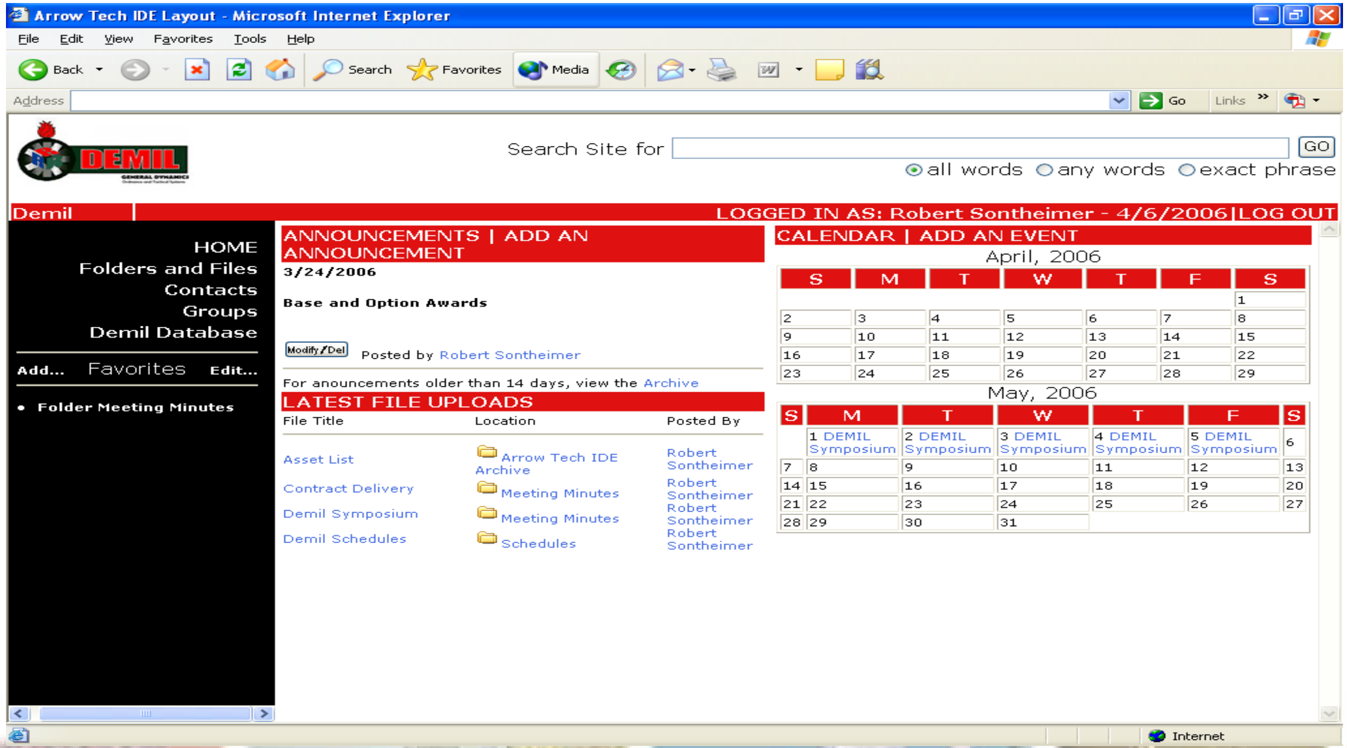


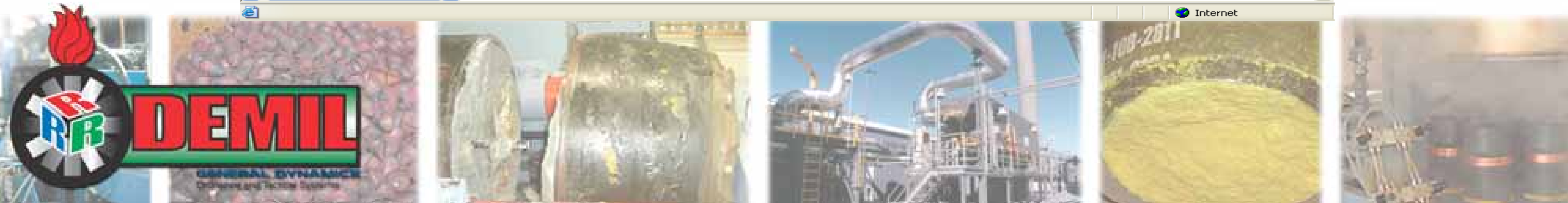


Planned IDE Document Repository

- **The 2nd Generation DEMIL Database will support an Integrated Data Environment**

- **The IDE HOME page will be available to our Demil Operators, Customers, and GD-OTS users to read, write, store, and announce information**



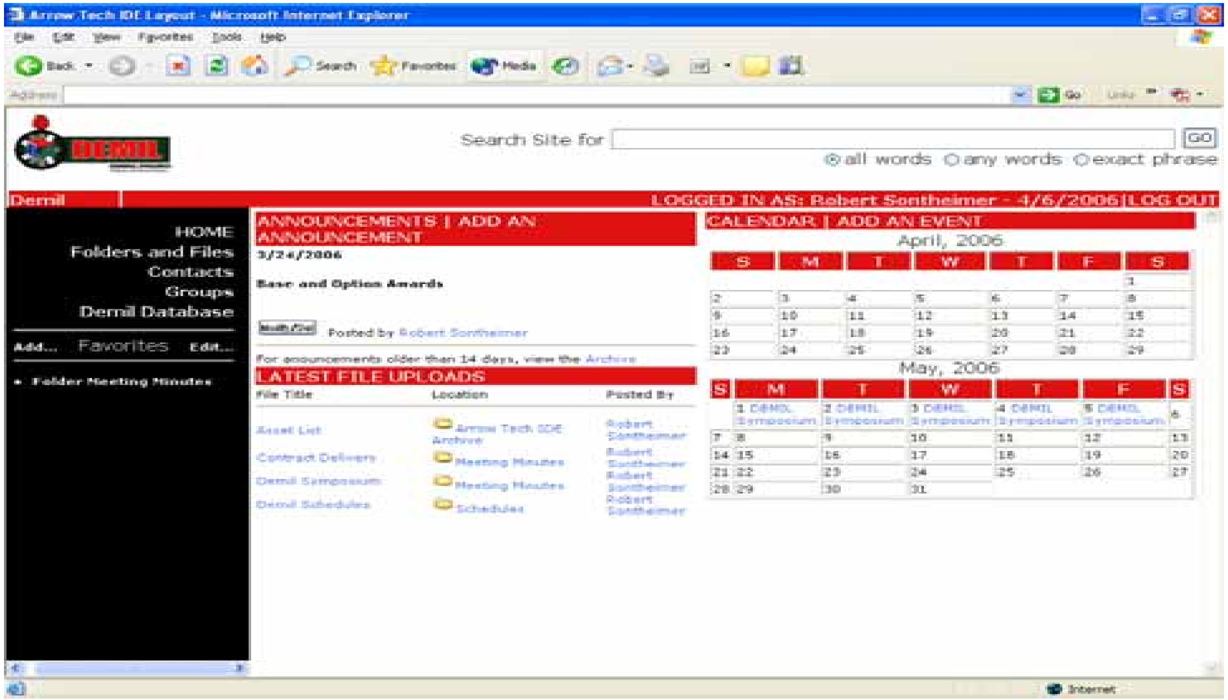


Integrated Data Environment Document Repository User Groups

- The users will be placed in independent groups and assigned folders for their data requirements
- The users will have the capability to post standard files and documents to the folders (i.e. Word, Excel, Project, PowerPoint)
- The IDE will announce when a new report is uploaded to a folder
- The users' PIN will grant them data privileges within their group assignment
  - A Read privilege limits the user to only reading a data file or saving the file to their personal computer.
  - A Write privilege grants the user capability to generate, change, and upload files to the Website.

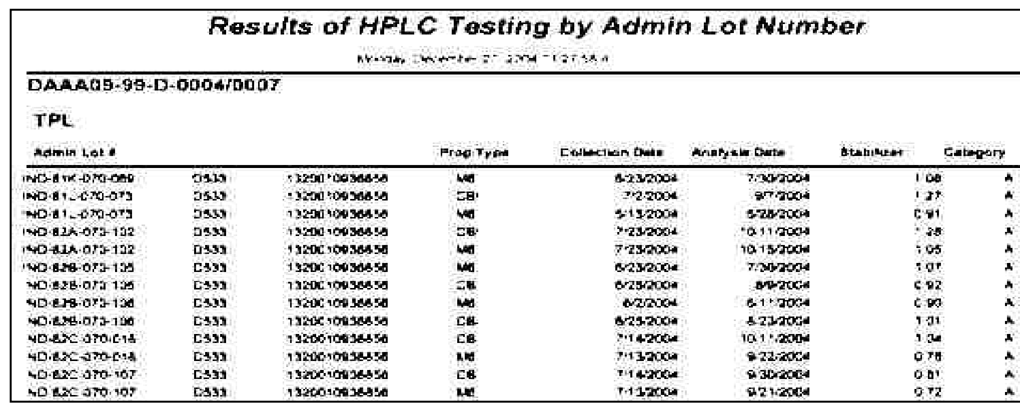
Integrated Data Environment Communication

- **The IDE HOME page will show a calendar of upcoming meetings, scheduled activities, and task assignments**
- **The IDE HOME page will have a Bulletin Board to announce DEMIL team news, contract awards, milestones, and events**



Planned E-mail Announcement Enhancement

- The system will automatically report the test results for the High Performance Liquid Chromatography (HPLC) lab tests
- The system will generate a test report for all of the manufacturing lot numbers which have been tested
- In addition the system will generate an alert notice for test lot results with less than .20 percent effective stabilizer



Results of HPLC Testing by Admin Lot Number

DAAA09-99-D-0004/0007

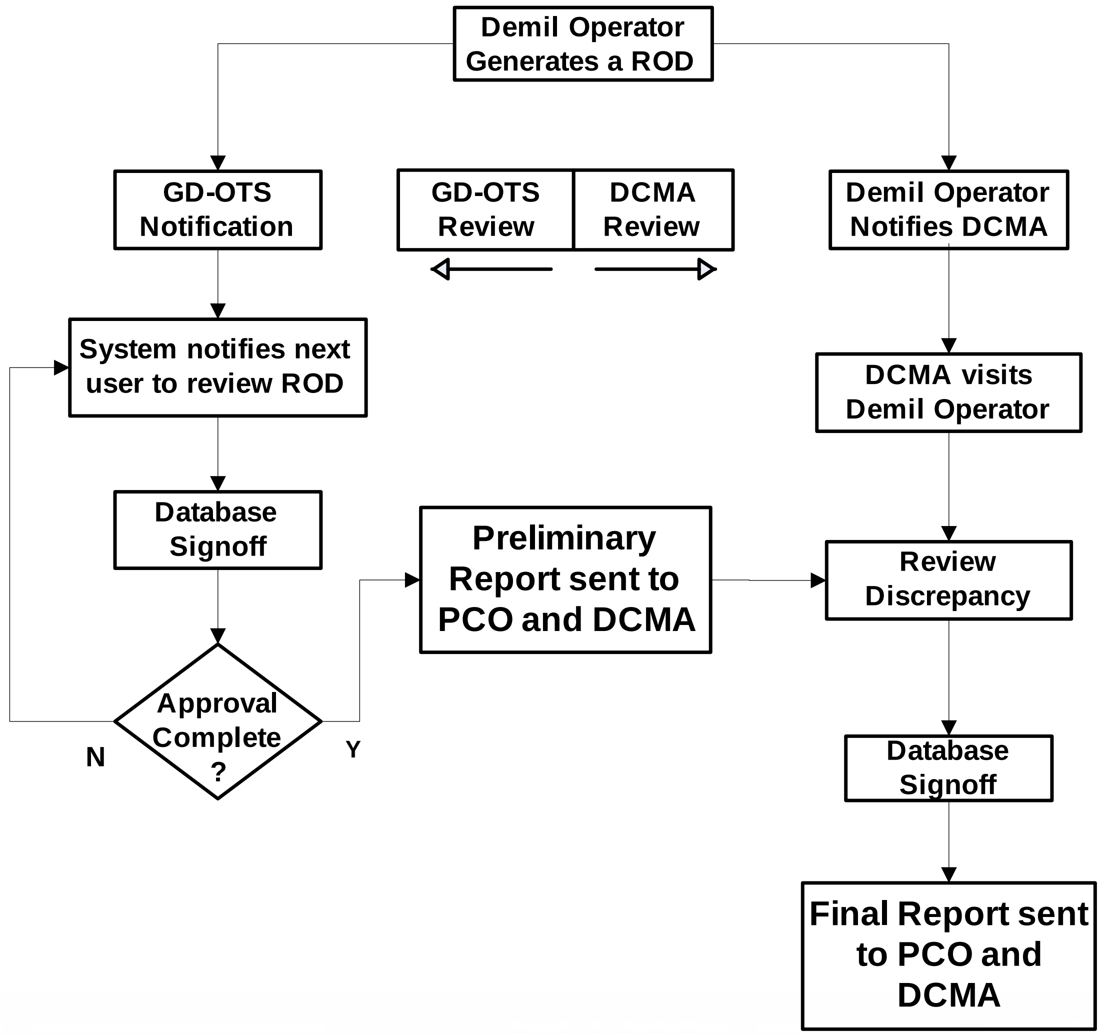
TPL

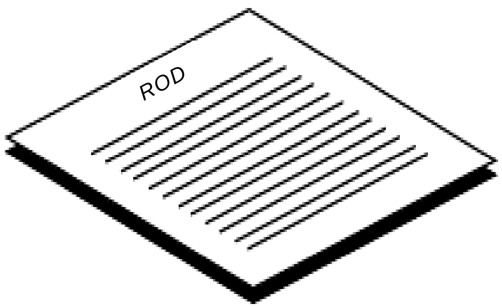
Admin Lot #			Prop Type	Collection Date	Analysis Date	Stabilizer	Category
IND-81K-070-069	D533	1320010936656	M6	6/23/2004	7/30/2004	1.08	A
IND-81L-070-073	D533	1320010936656	CBI	7/2/2004	9/7/2004	1.27	A
IND-81L-070-073	D533	1320010936656	M6	5/13/2004	5/28/2004	0.91	A
IND-82A-073-102	D533	1320010936656	CBI	7/23/2004	10/11/2004	1.28	A
IND-82A-073-102	D533	1320010936656	M6	7/23/2004	10/15/2004	1.05	A
IND-82B-073-105	D533	1320010936656	M6	6/23/2004	7/30/2004	1.07	A
IND-82B-073-105	D533	1320010936656	CB	6/25/2004	8/9/2004	0.92	A
IND-82B-073-106	D533	1320010936656	M6	6/2/2004	6/11/2004	0.90	A
IND-82B-073-106	D533	1320010936656	CB	6/25/2004	8/23/2004	1.01	A
IND-82C-070-014	D533	1320010936656	CB	7/14/2004	10/11/2004	1.04	A
IND-82C-070-014	D533	1320010936656	M6	7/13/2004	9/22/2004	0.78	A
IND-82C-070-107	D533	1320010936656	CB	7/14/2004	9/30/2004	0.81	A
IND-82C-070-107	D533	1320010936656	M6	7/13/2004	9/21/2004	0.72	A

Planned Workflow Enhancement

- Workflow will be added to the Report of Discrepancy (ROD) generation process
- The user's PIN will provide them access to the ROD system
- The PIN will determine the user's ROD responsibility and function
- During the workflow process the approver will have the capability to add data, approve the report, or reject the report.
- The system will generate messages to notify GD-OTS, DCMA and the PCO the status of the ROD generation and approval process

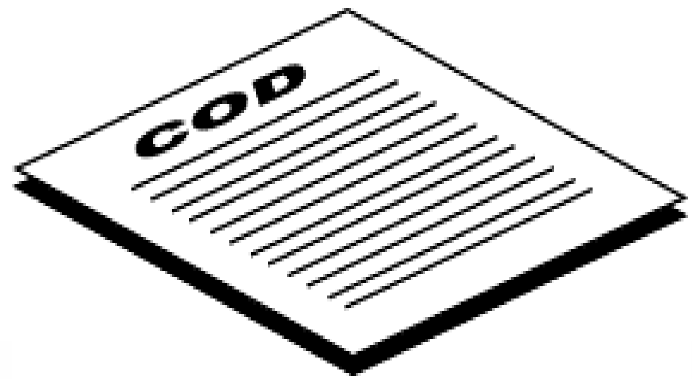
Planned Workflow Enhancement





Planned Reporting Enhancement

- The Monthly Demil Progress Report will be prepared using input from every Demil Subcontractor
- After all data has been input, the report information will be collected and summarized into a progress report and submitted to the Customer
- Some of the data elements to be reported are:
  – Item/DODIC
  – Quantity processed
  – Summary of closed disposal process
  – Results of external reviews and audits



Summary

- Secure data input and report viewing from across the world
- The Internet access speeds up communication since the data is current and available real-time
- 24/7 access of production data by the System team
- In use for the past nine years by GD-OTS, our customer, and our subcontractors
- Integrated Data Environment for upgraded document repository
- Integrated Data Environment for enhanced communication
- E-mail announcement
- System controlled workflow
- Improved progress reporting to our customer

GD-OTS Demil Team

QUESTIONS?

Using the Munitions Analytical Compliance Suite (MACS) to Quantify Your ISO 14001 EMS

14th Global Demil Symposium
May 1-5, 2006
Indianapolis, IN

George R. Thompson, Ph.D.
Kevin Kennedy
Chemical Compliance Systems, Inc.

Environmental Management System (EMS) Implementation Criteria and Metrics*

1. An environmental policy statement consistent with DoD and Component EMS policies.

2. A self-assessment consistent with DoD and Component EMS policies

3. A written plan with defined dates, identified resources, and organization responsibilities for implementing an EMS consistent with DoD and Component EMS policies

4. A prioritized list of aspects.

5. Appropriate installation personnel have received awareness-level EMS training

6. Completed at least one management review in accordance with the installation's documented procedure for recurring internal EMS management review

___

*Assistant Deputy Under Secretary of Defense (Environment) memorandum 30 Jan 2003

ISO 14001 EMS Qualitative Requirements

Policy

↓

Objectives/Goals

↓

Targets/Requirements

↓

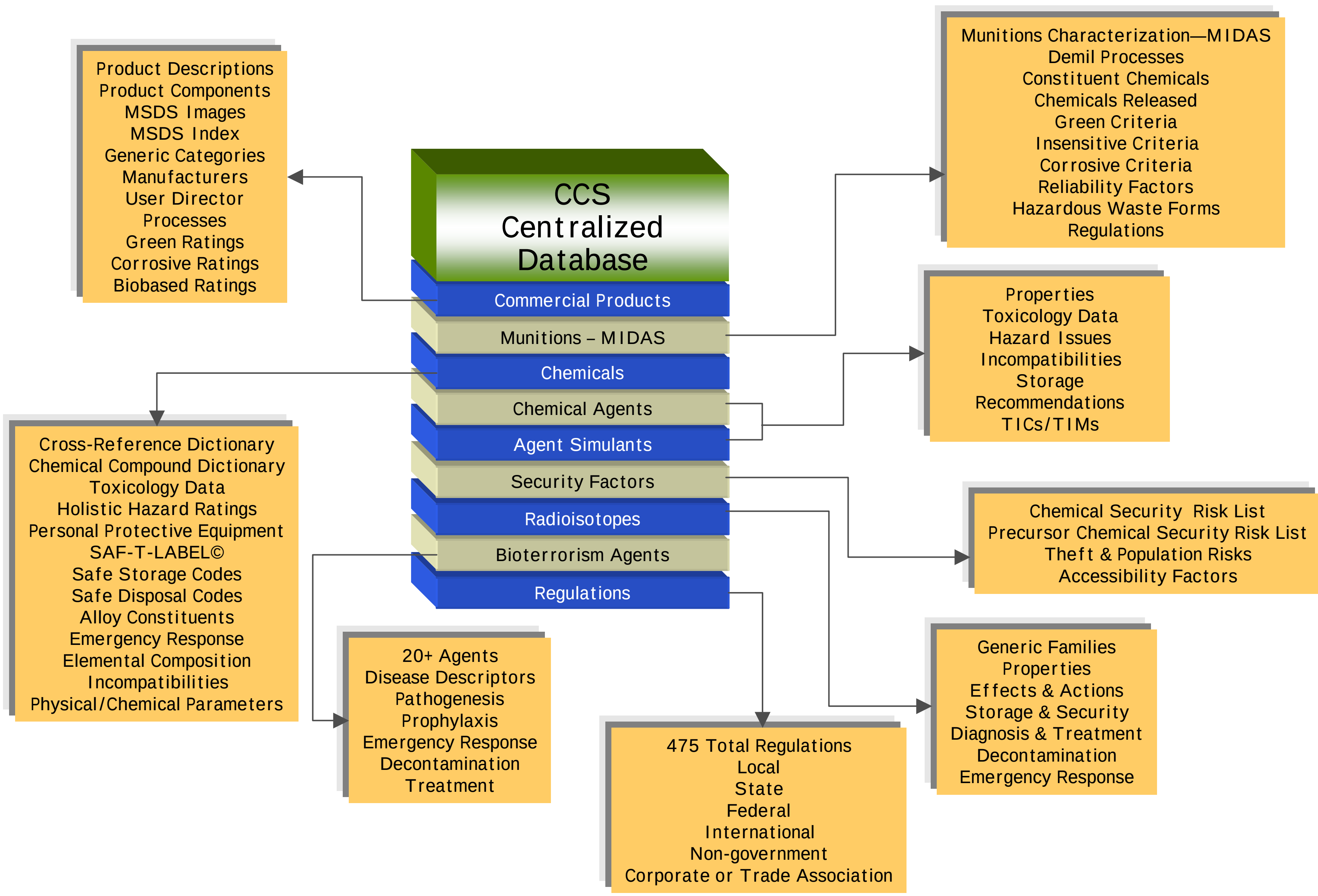
Aspects/Impacts

↓

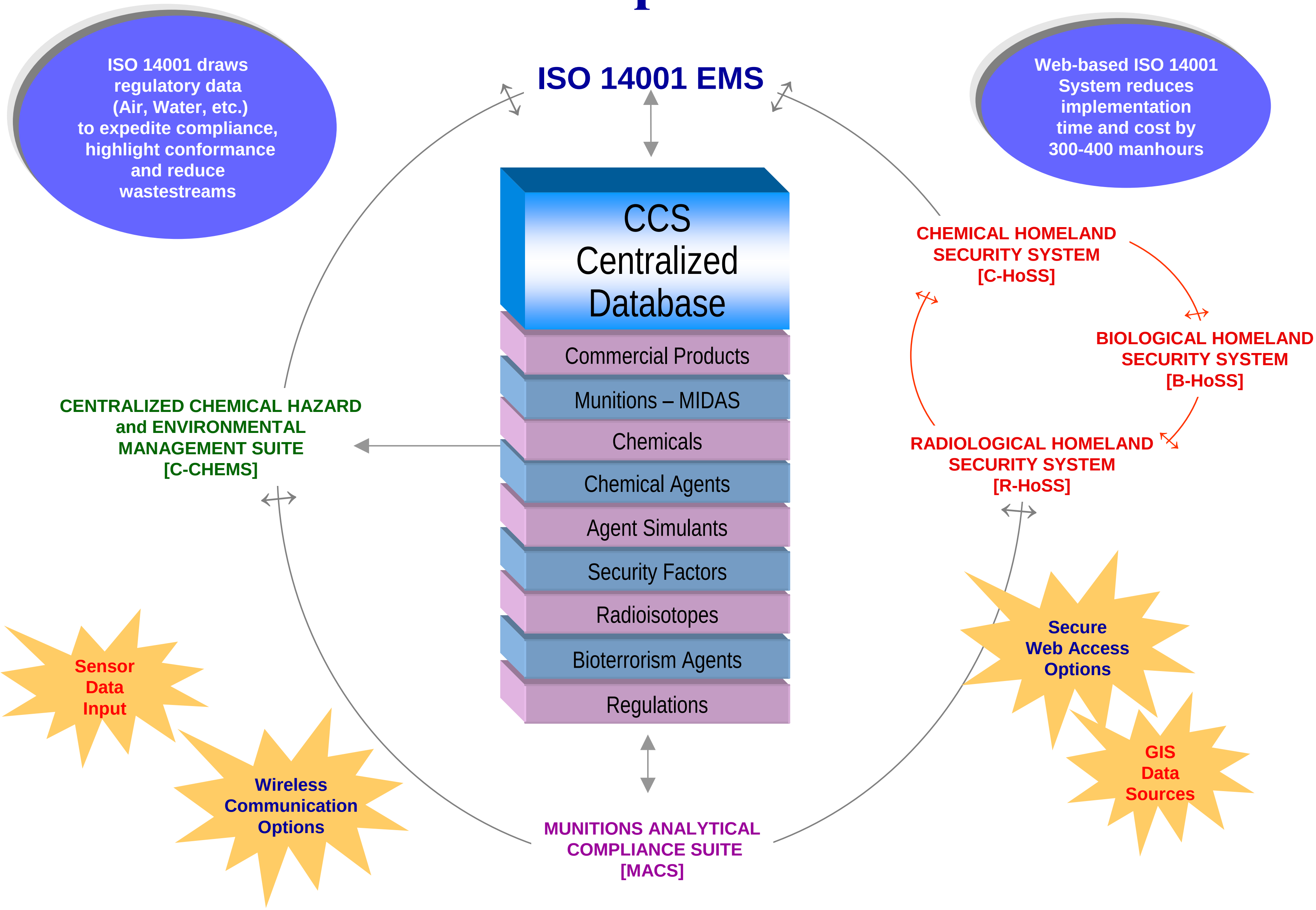
Management Program

Responsibilities ✂ Schedule ✂ Training ✂ Documentation ✂ Emergency Preparedness Measurements ✂ Recordkeeping ✂ Management Review

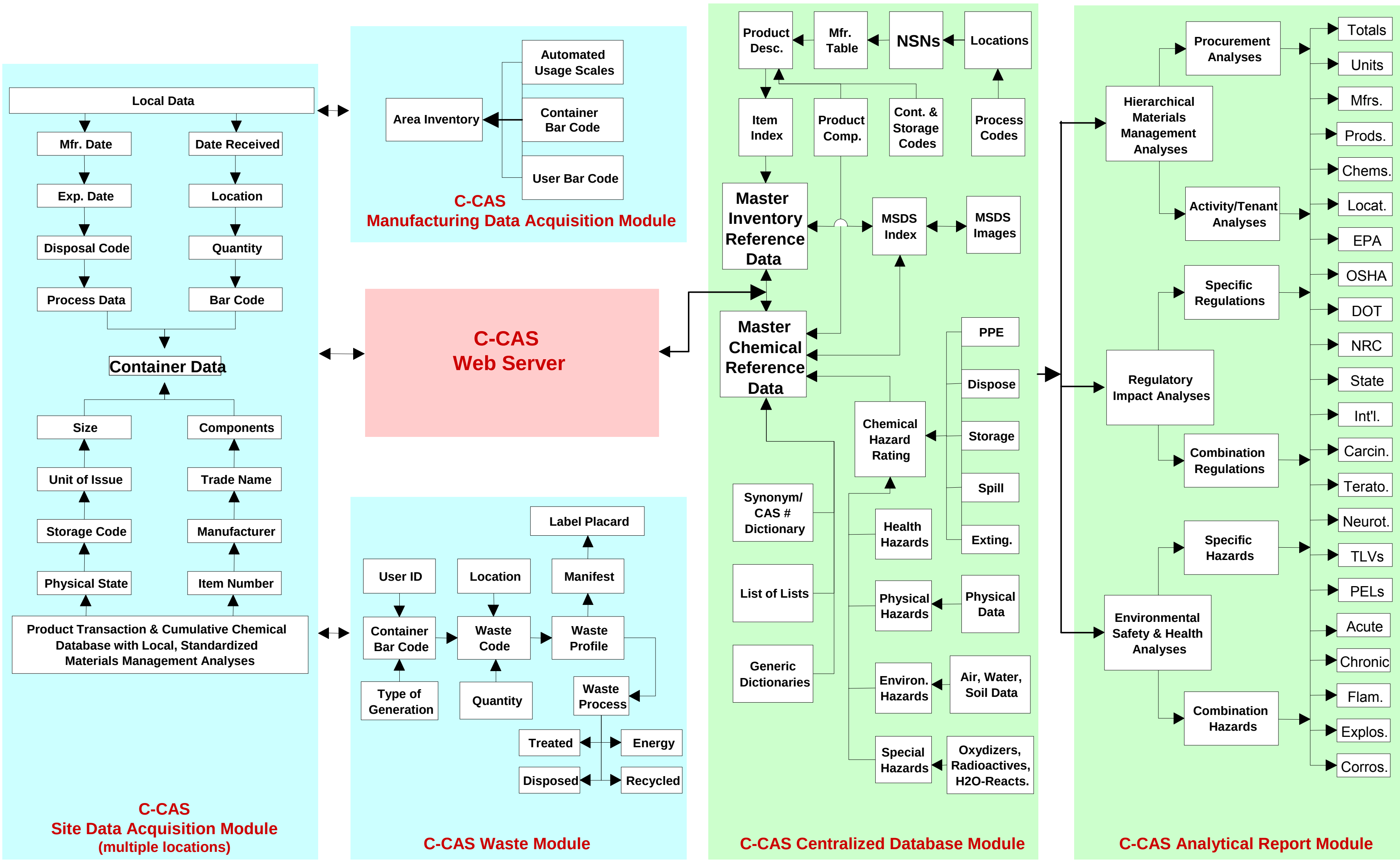
The CCS Relational Chemical and Product Database (R-CPD)



CCS Capabilities

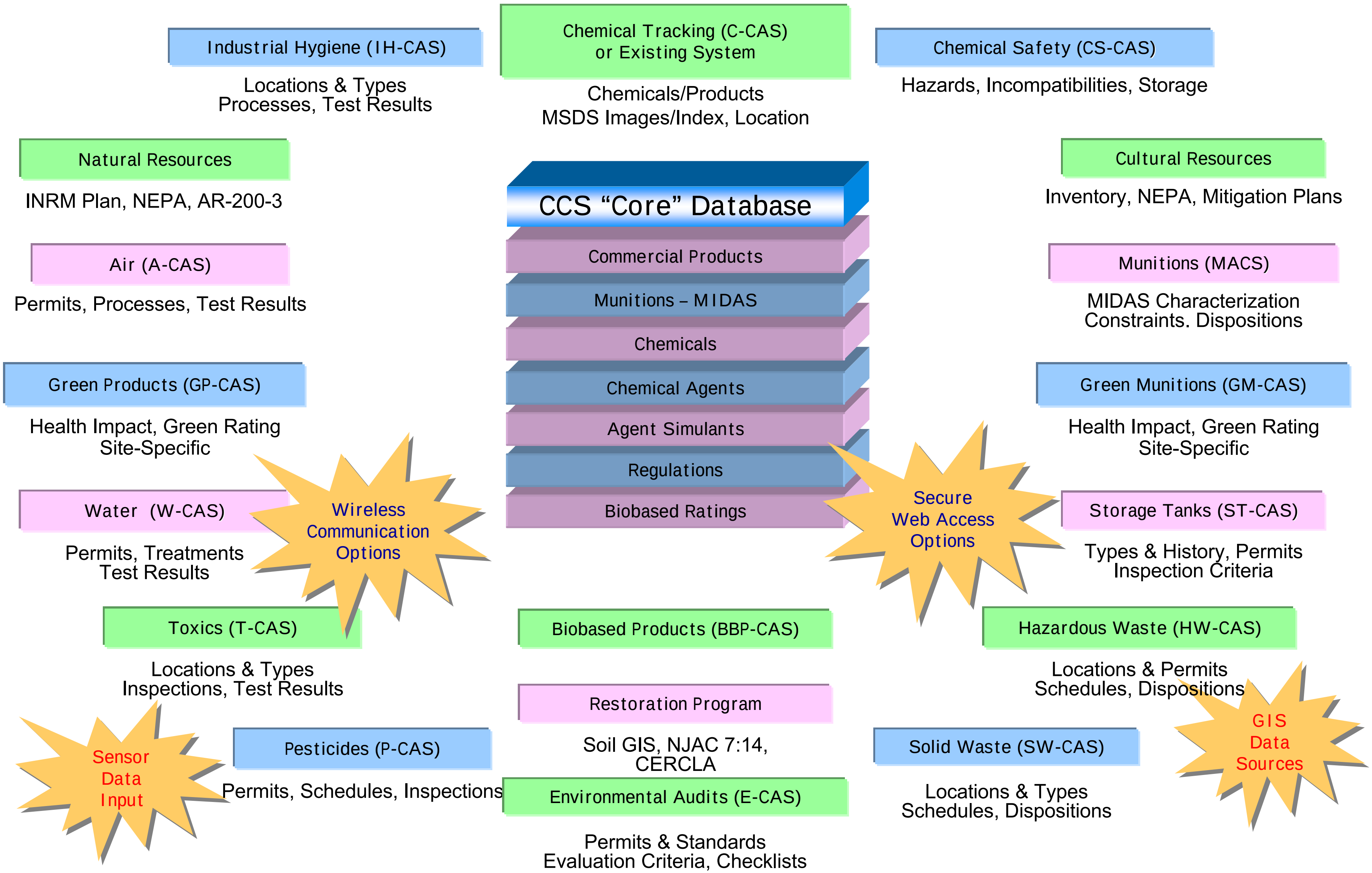


Chemical Compliance Analytical System (C-CAS)



Centralized Chemical Hazard and Environmental Management Suite (C-CHEMS)

Centralized and Relational Databases



CCS MSDS Retrieval System Capabilities

MSDS Retrieval System for Product Hazard Information (MRS-PHI)

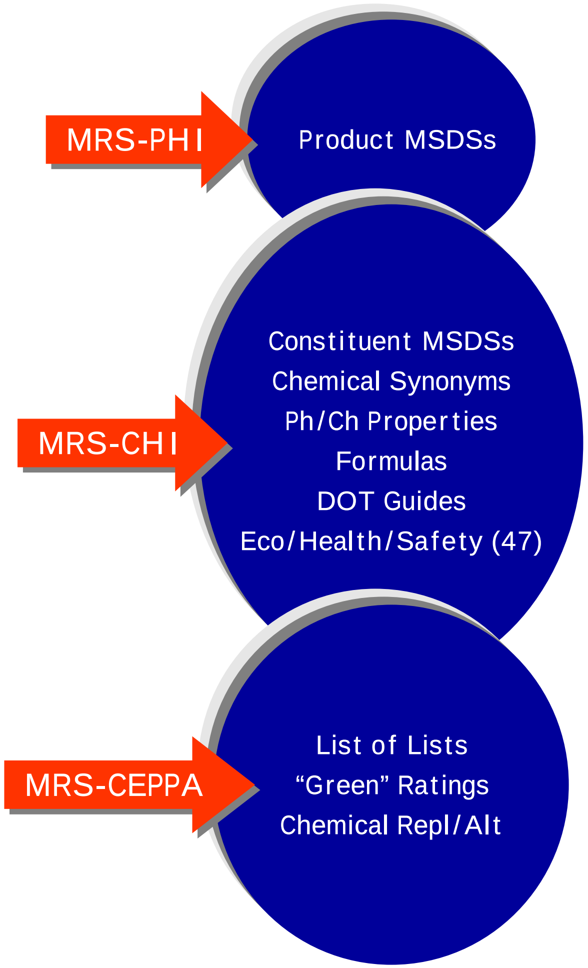
This basic Web-based system is designed for two specific applications: [1] manufacturer utilization to make their MSDSs electronically available to their customers, and [2] employer utilization to make their MSDSs electronically available to their employees. MRS-PHI includes an image of each MSDS and a simple index that identifies the product of interest to facilitate customer or employee retrieval of the MSDS. This system can be maintained by the manufacturer/employer, or by CCS for a separate fee.

MSDS Retrieval System for Chemical Hazard Information (MRS-CHI)

This more sophisticated Web-based system is designed to facilitate comprehensive evaluations of each MSDS. MRS-CHI not only includes an image of each MSDS, but also includes an expanded index and search engine and an MSDS for each product constituent chemical. Additionally, MRS-CHI includes the following files for each constituent chemical: [1] synonyms, [2] physical properties, [3] ecological, health and safety data, and [4] USDOT Transportation Guides. MRS-CHI can, therefore, compile the requisite reference information for the product, all constituent chemicals, or any selected constituent chemicals. This system is maintained by CCS on our Web server.

MSDS Retrieval System for Chemical and Environmentally Preferable Product Analyses (MRS-CEPPA)

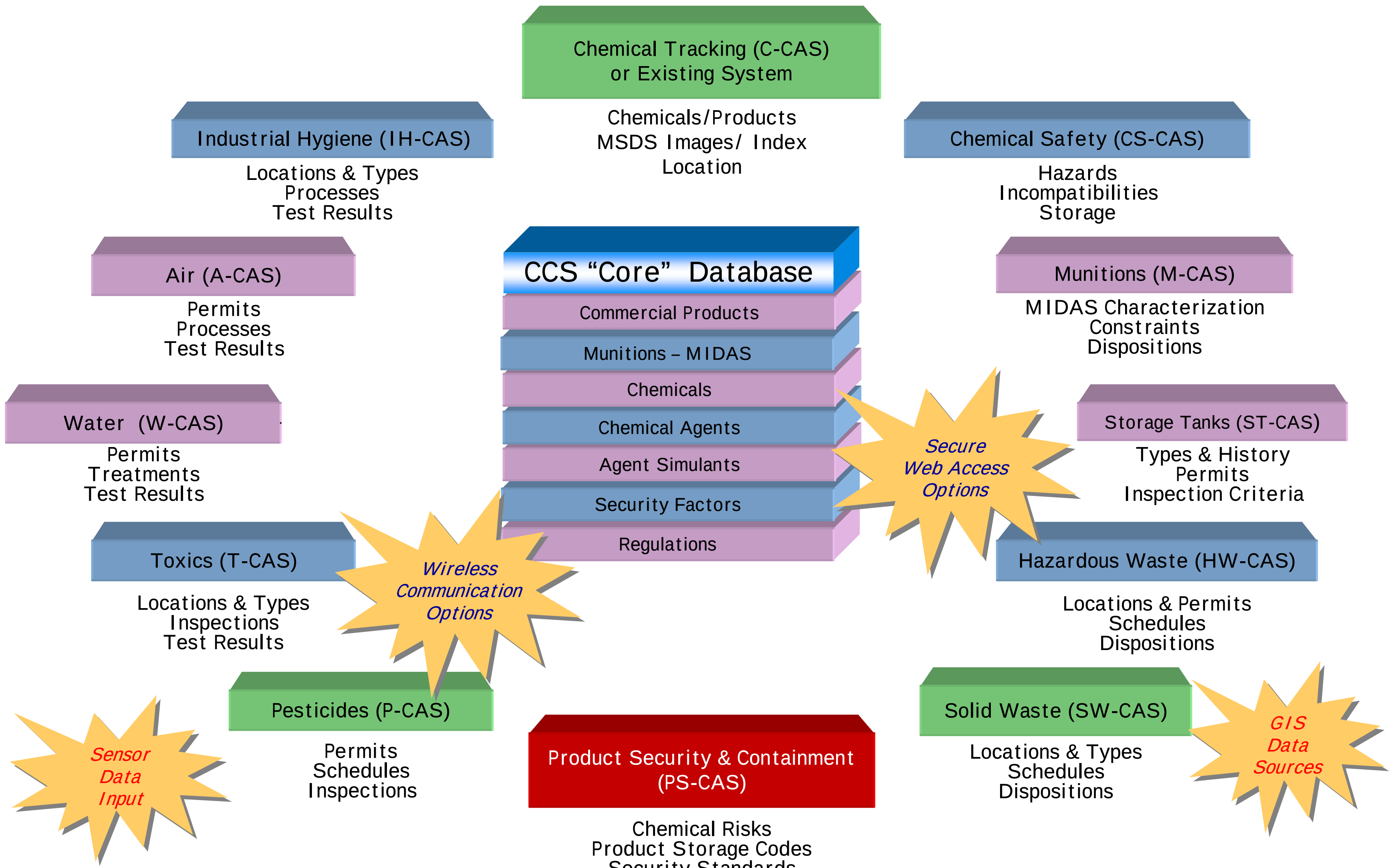
This comprehensive system includes all of the data in MRS-PHI and MRS-CHI and additionally includes 475 state, federal and international regulatory lists of chemicals, chemical formulas, chemical "green" evaluation ratings and a chemical constituent replacement/alternative database. MRS-CEPPA can, accordingly, identify the elemental composition of a product, calculate a "green" rating for a product (0% is worst, 100% is best), identify chemical regulations affected by the product (e.g., TRI, HAPs, ODSs, etc.), and recommend potential chemical constituent replacements/alternatives that will improve the "green" rating, or decrease the regulatory impact, of the product. MRS-CEPPA is also maintained by CCS on our Web Server.



MRS-PHI, MRS-CHI and MRS-CEPPA have been designed so that databases and analytical capabilities can be incrementally added to progress from one system to the next, thereby progressively increasing the analytical sophistication. This approach allows costs to be spread across several budget cycles, if needed.

Chemical Homeland Security System (C-HoSS)

Centralized and Relational Databases



C-HoSS Security Criteria and Standards

- **Chemical Hazard Class Rankings (*by Hazard Class*)**
- **Chemical Hazard Grades (1-4) (*within each ranking*)**
- **Product Concentration Grades (1-4)**

Chemical Hazard Factor (CHF) = Ranking × Grade × Concentration

- **Theft Risk Grades (1-4) (*per product*)**

Chemical Security Risk Factor (CSRF) = Ranking × Grade × Concentration × Theft Risk

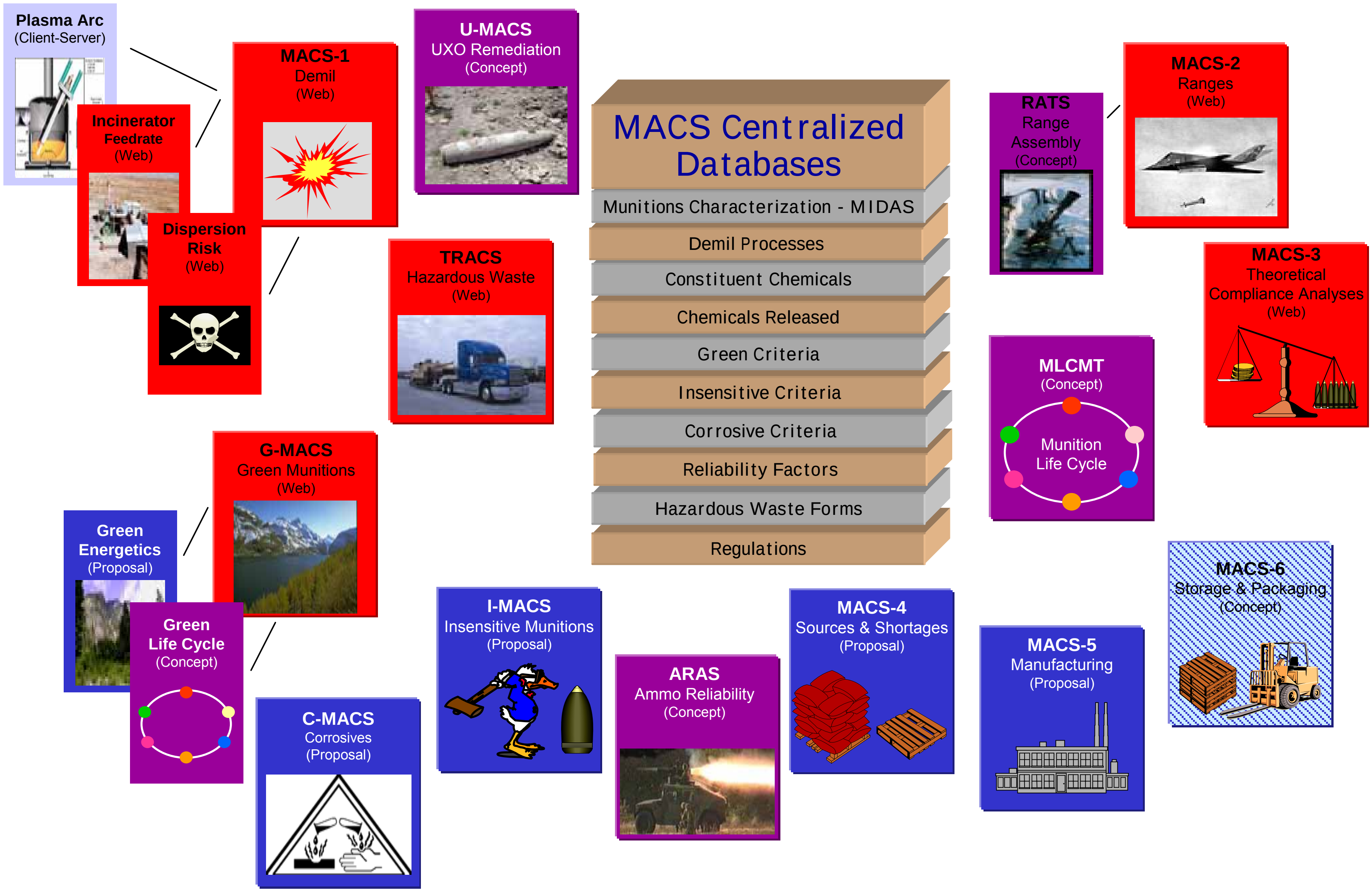
- **Population at Risk Grades (1-4)**

Chemical Mortality Risk Factor (CMRF) = Ranking × Grade × Concentration × Theft Risk × Population Risk

- **Accessibility Factor Levels (*Storage Constraint Levels and Descriptors*) (0.5 - 4.5)**

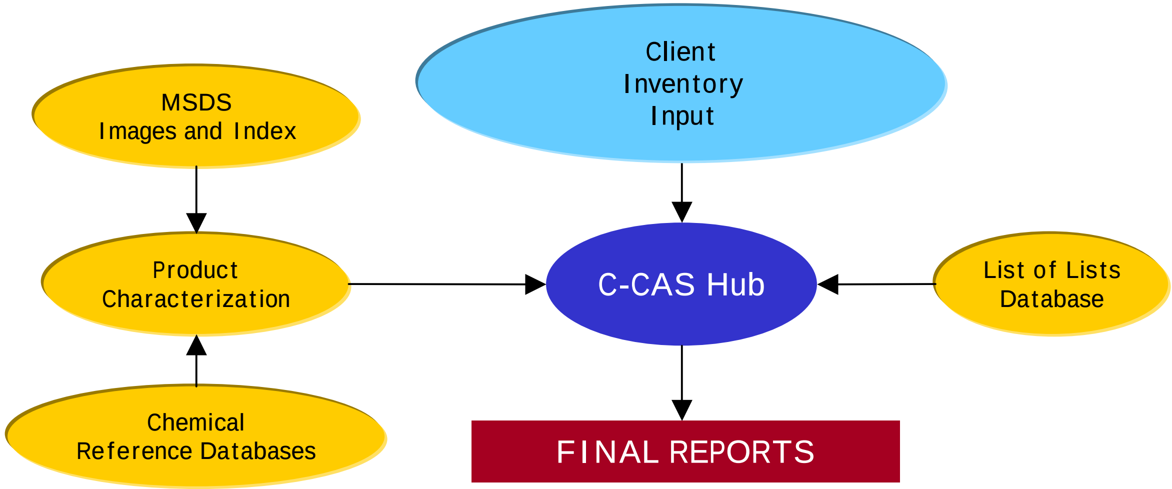
CMRF ❍ Accessibility Factor (AF) = Vulnerability Factor (VF)

Munitions Analytical Compliance Suite (MACS)

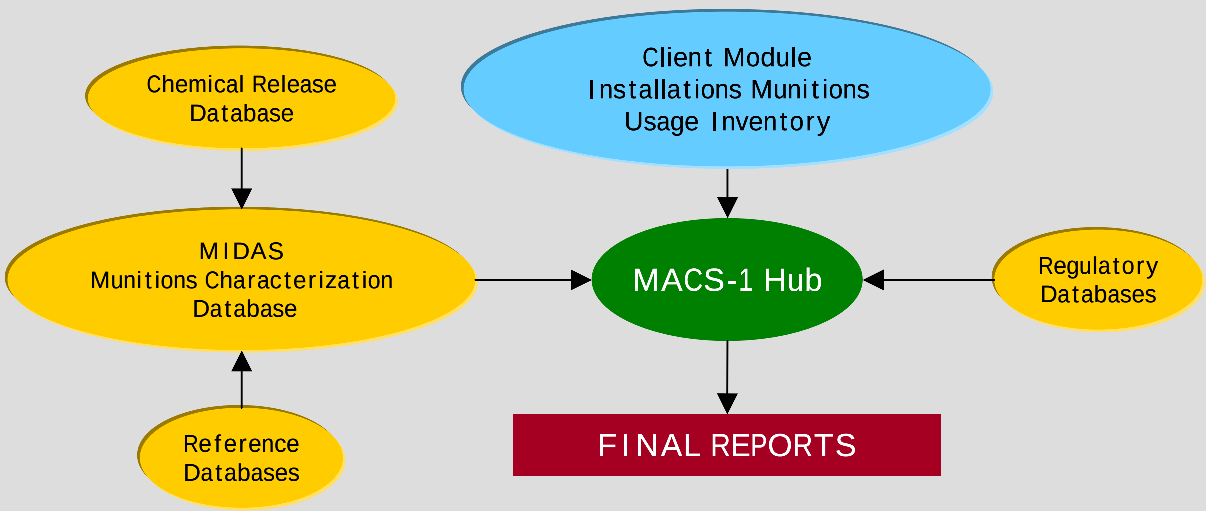


C-CAS Derivative Systems

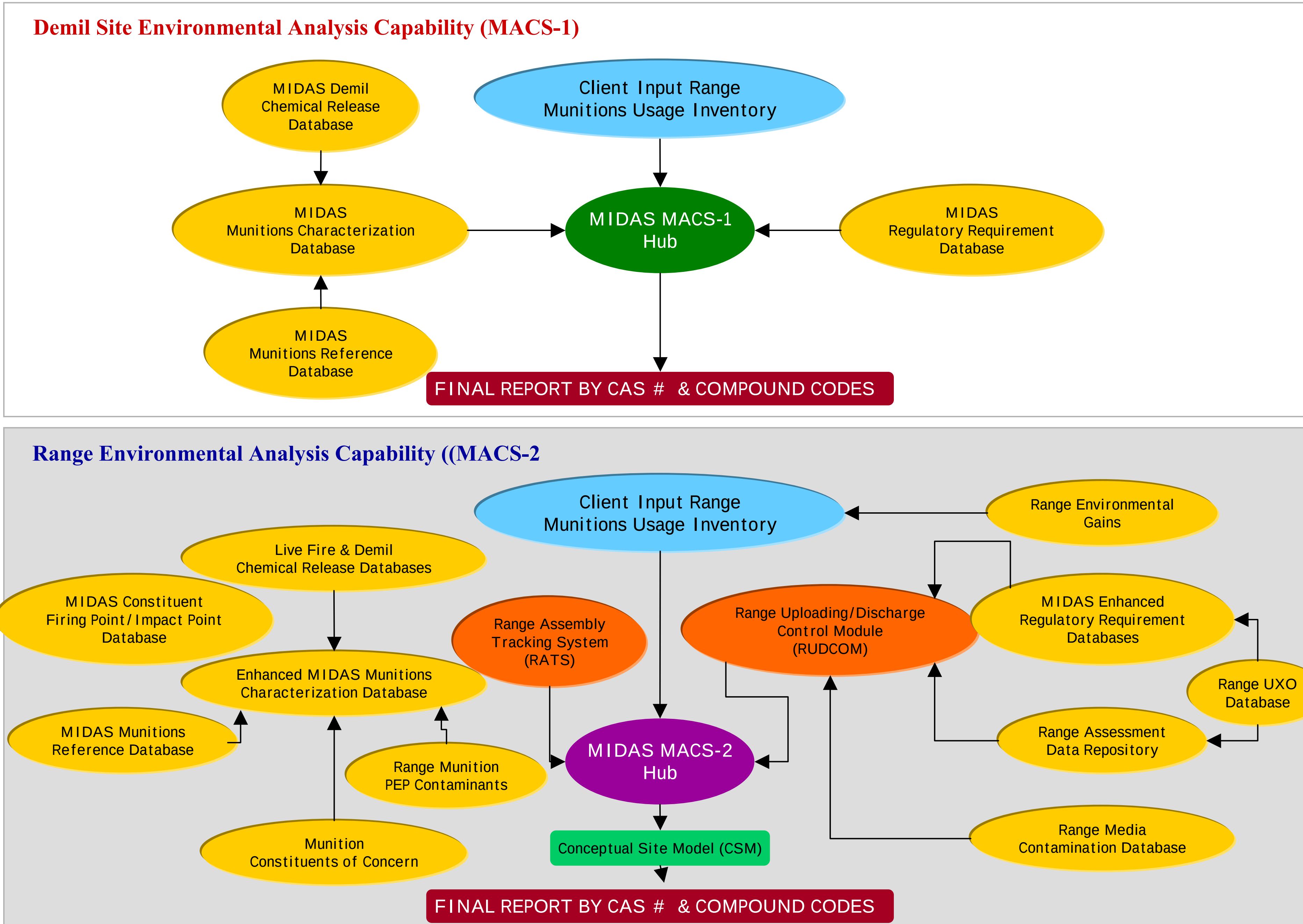
Chemical Compliance Analytical System (C-CAS)



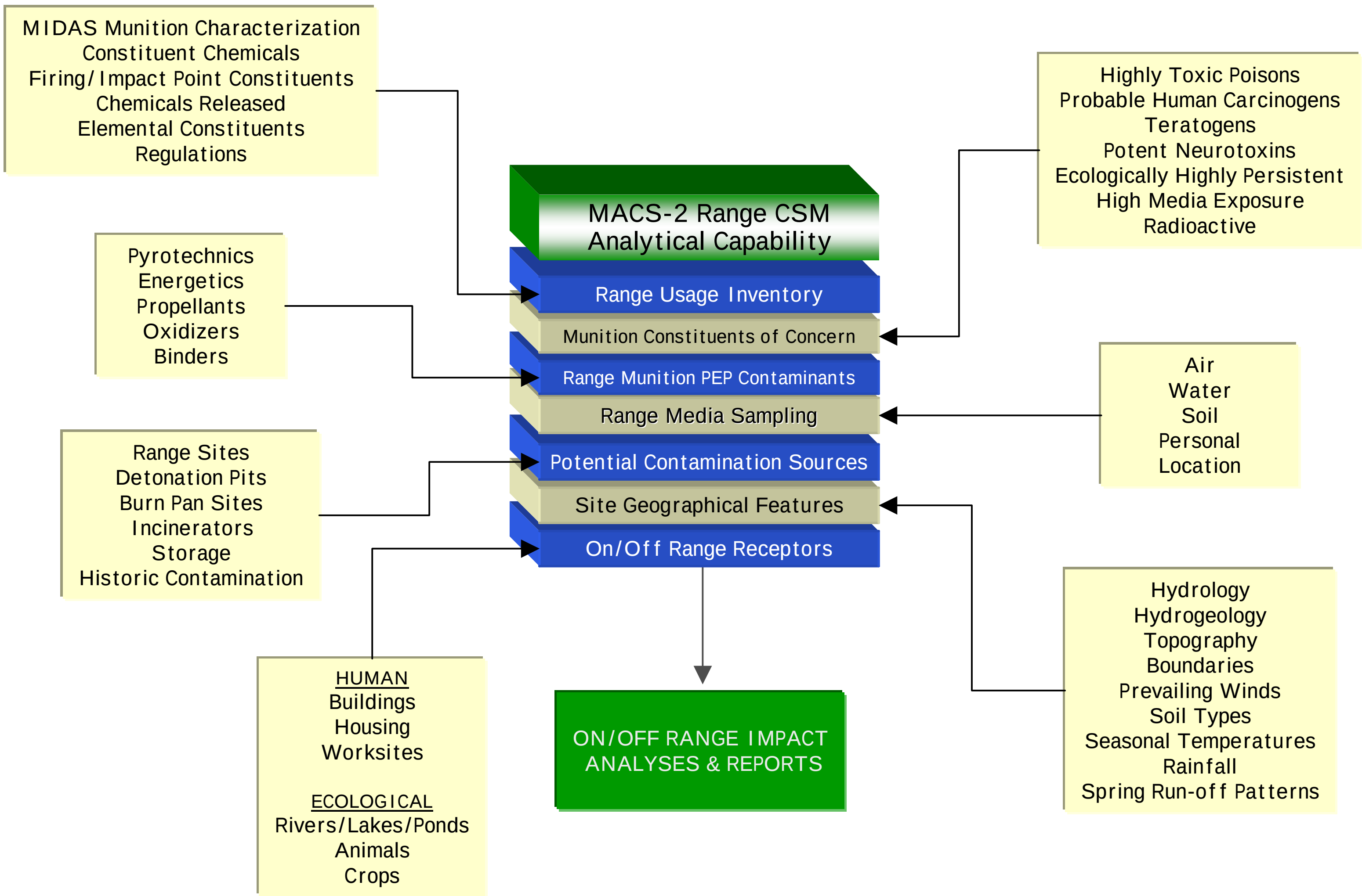
Munitions Analytical Compliance System for Demil (MACS-1)



Web-based MACS-2 Customization from the Existing MACS-1 Module

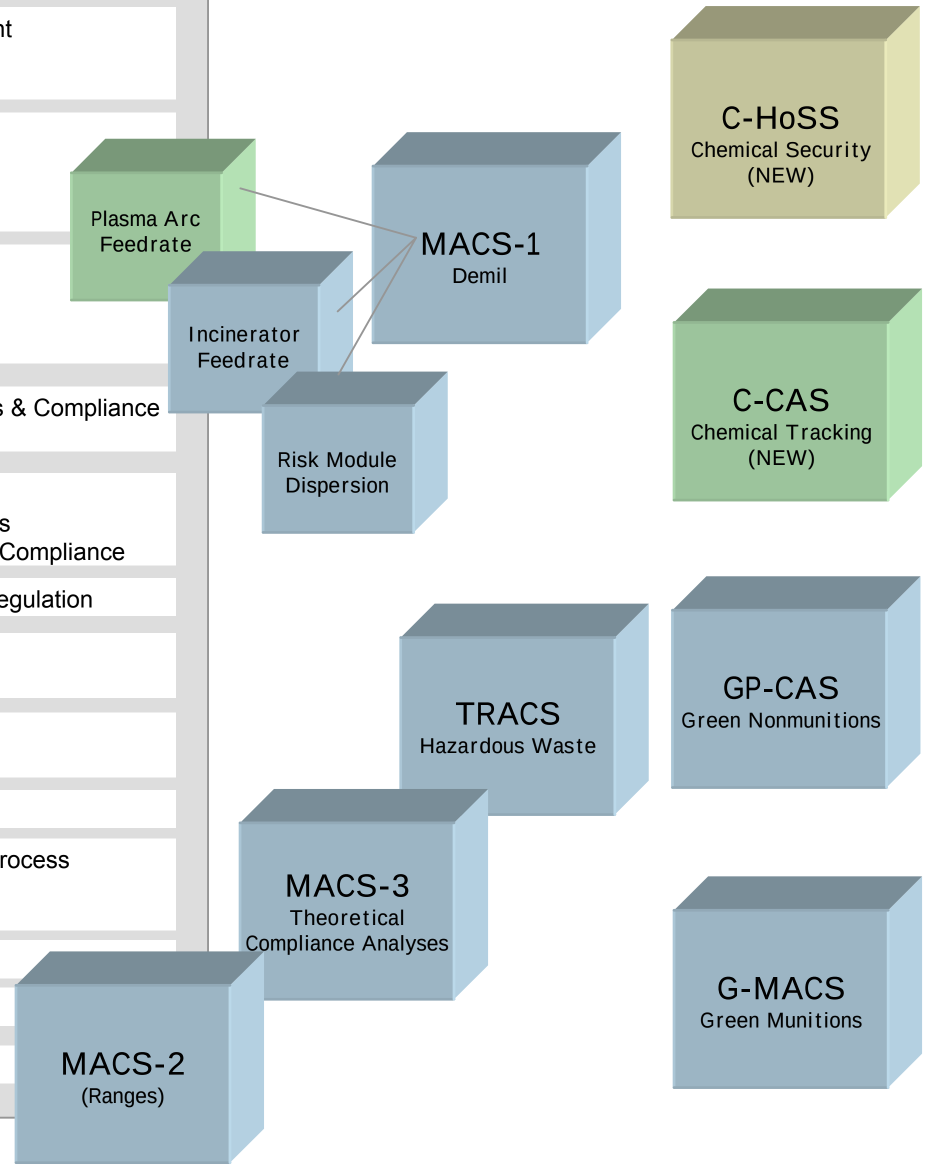


MACS-2 Range Conceptual Site Model (CSM)

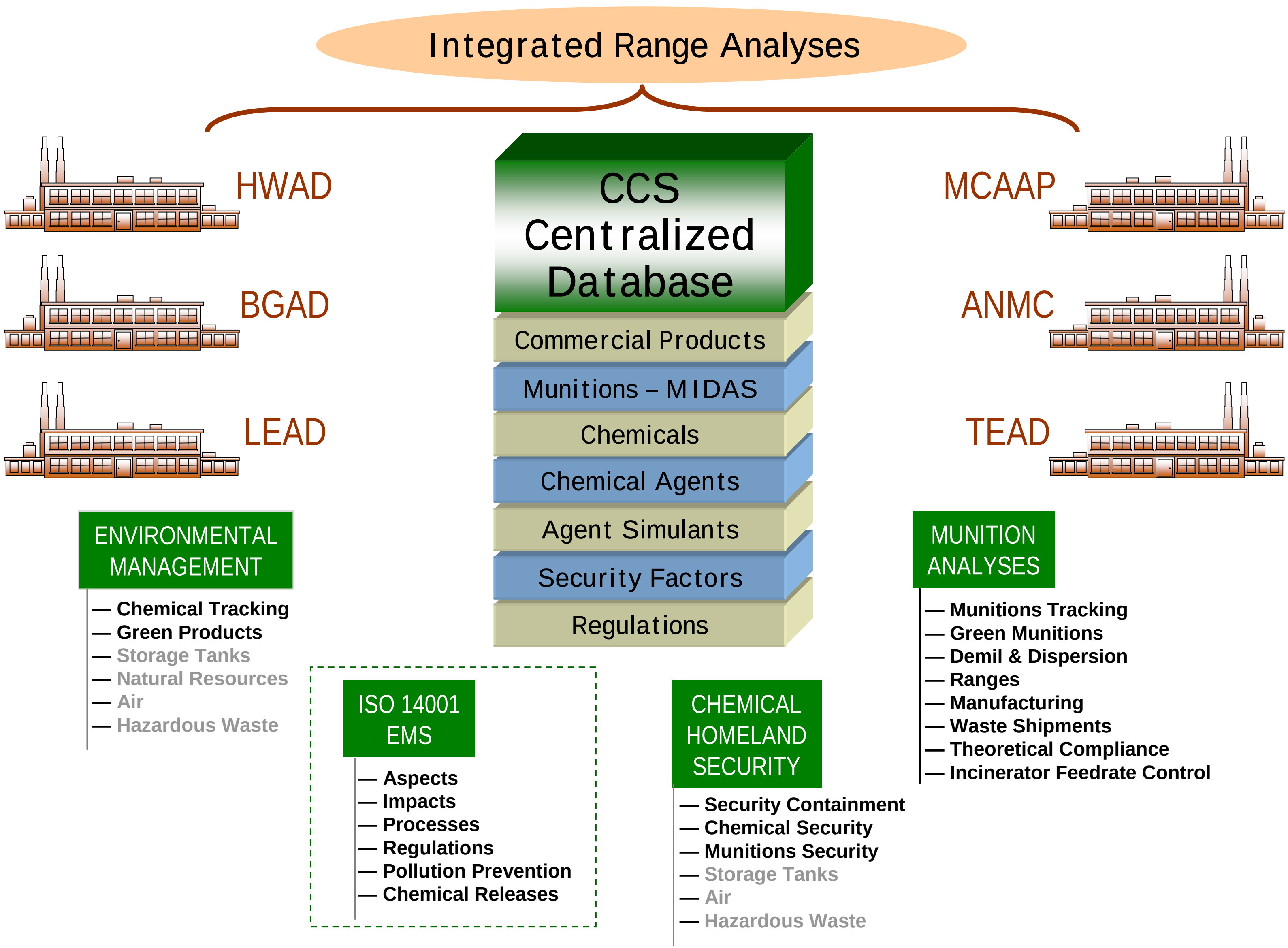


MACS Integration Into Facility ISO 14001 EMS

POLICY	Multi-functional DoD Green Procurement Program Fulfillment Munition/Nonmunition P2 and Regulatory Compliance Munition/Nonmunition Security
OBJECTIVES/ GOALS	By Demil Operation By Specific Range & Operation For Procurement—Hazard Acquisition Constraints Security Incident Prevention
TARGETS/ REQUIREMENTS	By Level, Function, Product Type & Restricted Constituents Within Permit Constraints By Demil/Range Operation & Regulation Storage Requirements by Area & Function
ASPECTS/ IMPACTS	Decrease/Increase Acquisition, Usage Releases, Exposures & Compliance Security Risks, Incidences, First Responder Analyses
MANAGEMENT PROGRAM	No Hierarchical Data Calls “Broad Picture” of Operations, Processes, Areas & Functions Integration of Munition, Nonmunition & Security Analyses & Compliance
RESPONSIBILITIES	Definable by Area, Level, Function, Process, Operation & Regulation
SCHEDULE	Periodic Interim Status Reports By & Across Module(s) Integrated Documentation & Validation
TRAINING	Simplified by Criteria, Pass/Fail Values Operation, Process & Area-Specific
DOCUMENTATION	Within Each Module
EMERGENCY PREPAREDNESS	Product & Constituent Data by Hazard, Area, Operation & Process Imaged Documents Decreased Incidence Likelihood & Severity
MEASUREMENTS	Within Each Module—Hazards & Compliance
RECORDKEEPING	Within Each Module
MANAGEMENT REVIEW	Annual Executive Review & Interim Detailed Reports



Integrated Environmental, Munitions and Homeland Security System for Range Sustainment



Integrated System Benefits

BROAD BASED CAPABILITY

- Environmental
- Munitions
- Homeland Security
- EMS Enhancements

STANDARDIZED

- Reference Databases
- Established Criteria
- Calculation Algorithms
- Data Calls Eliminated

SCALABLE

- Local Control
- Enterprise System
- Small Base
- Military Service

FLEXIBLE

- Regulatory/Data Changes
- Diverse Users
- Summary Reports
- In-depth Analyses

EXPANDABLE

- Currently 14 Modules
- Potentially > 48 Modules
- Incremental Improvements
- New Directives

MINIMAL COST

- Development
- Maintenance
- Enhancement

GOVERNMENT CO-OWNED

Using the Munitions Analytical Compliance Suite (MACS) to Quantify Your ISO 14001 EMS

For a remote demonstration, or more information, contact…

Dr. George Thompson
973-663-2148
georgethompson@chemply.com

Kevin Kennedy
973-663-2148
kevinkennedy@chemply.com

Chemical Compliance Systems, Inc.
706 Route 15 South, Suite 207• Lake Hopatcong, NJ 07849
www.chemply.com

GENERAL DYNAMICS

Ordnance and Tactical Systems

14th Global Demil Symposium

May 1 – 5, 2006

DEMILITARIZATION

Resource Recovery, Recycling and Reuse of JA-2 Propellant

Dave Grymonpré, Ph.D.
Systems Engineer
727-578-8363
dgrymonpre@gd-ots.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

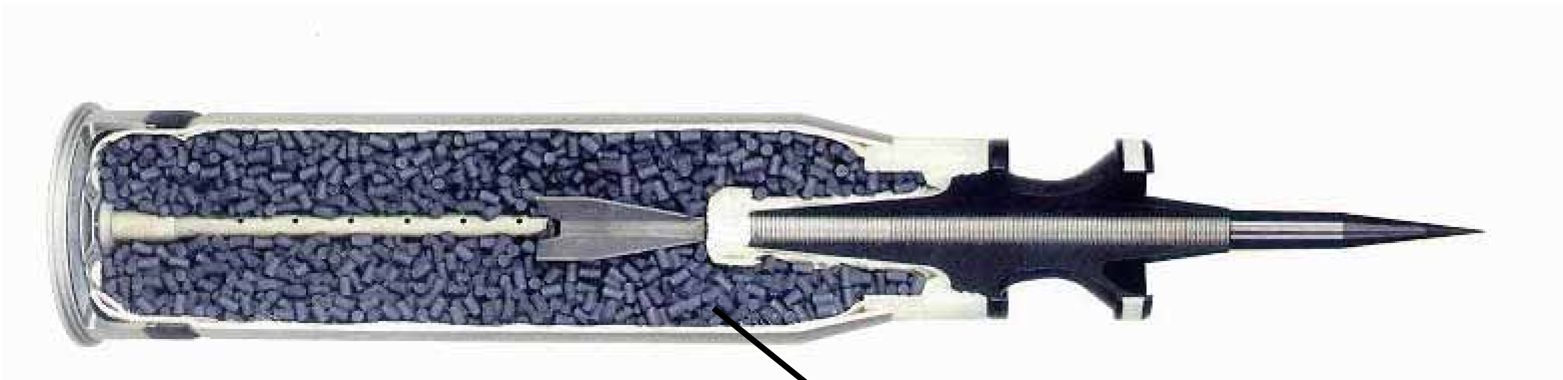
DEMIL 2005
GENERAL DYNAMICS

An Untold Demil Success Story

- Excellent Recovery and Reuse (R^4) of Energetics
- Successful effort to sustain the warfighter
- Came from an urgent need to develop a new tank round to respond to a threat in urban fighting for close-in defense
- Compressed timeframe to develop and field a new tank weapon
- Reduced development and production costs

Demil Background Information

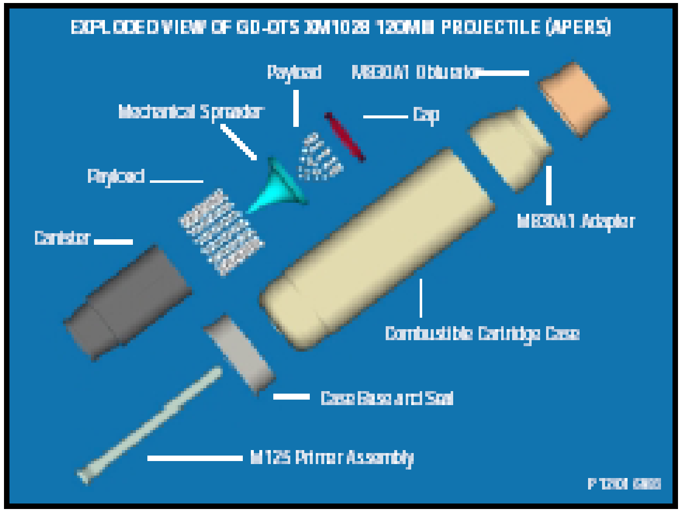
- Un-fielded, obsolete M829 Tank Rounds were scheduled for demilitarization beginning in 2002
- Iowa Army Ammunition Plant (IAAP) was awarded a contract to demil the rounds
- JA-2 Propellant was downloaded from the rounds and was stored at IAAP (slated for open burn)
- A total of 2.3 million pounds JA-2 has been open burned



M829 Tank Round JA-2 Propellant

Convergence of Demil and Development

- In 2001/2002 PM MAS, ARDEC and GD-OTS were developing a new 120mm tank round XM1028 for urban fighting
- Usually development of a new round includes a **lengthy** propellant qualification
- One option to compress development time and to reduce cost was to evaluate existing propellant used in similar applications
- A readily available propellant source was sought in place of new expensive propellant
- Interior Ballistic modeling indicated that JA-2 with a similar dimension as the M829 would work
- One alternative was to recover the JA-2 in storage at IAAP



Propellant and Round Verification Steps

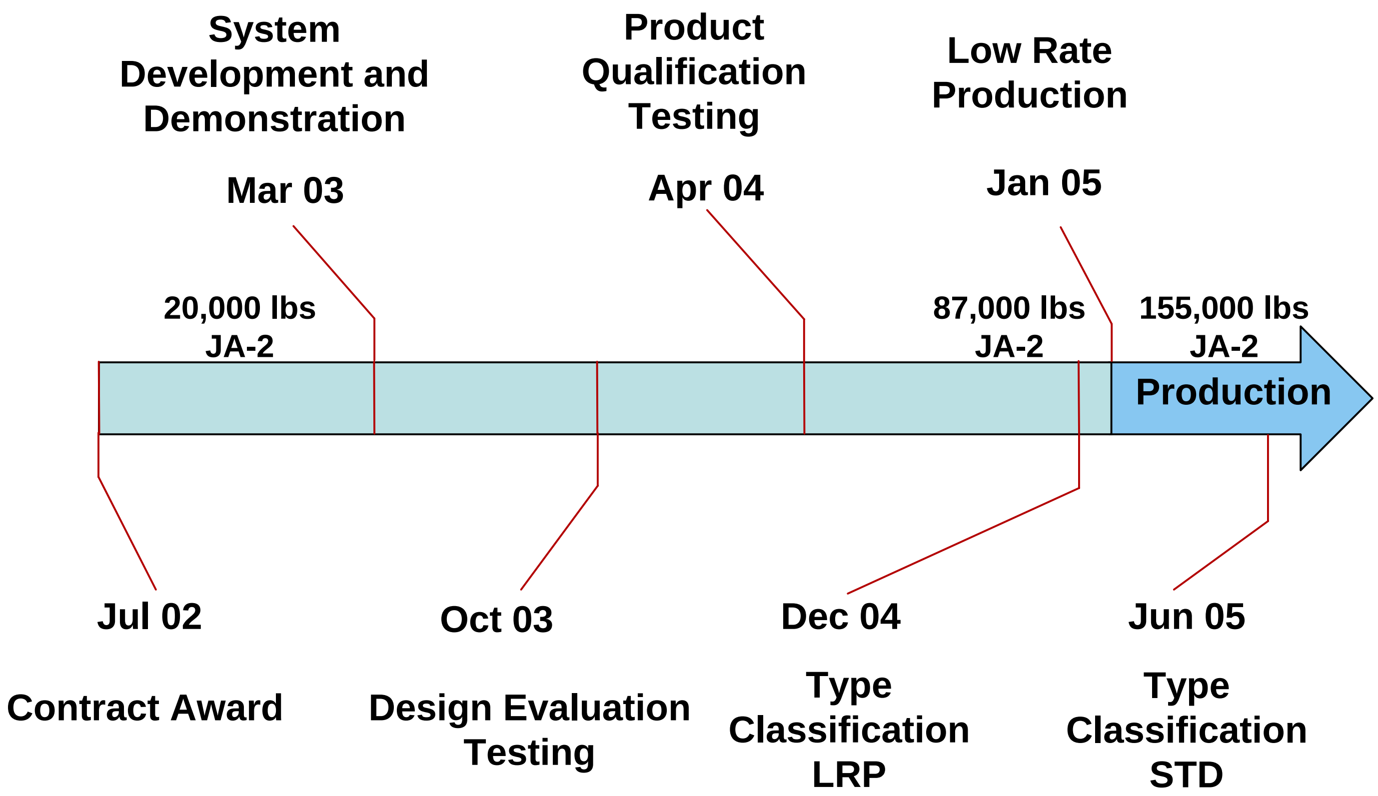
1. **Design Evaluation Testing (DET)**
   - **JA-2 Propellant Evaluation**
   - **Metal Parts Evaluation**
2. **Product Qualification Testing (PQT)**
   - **Qualification of entire cartridge including JA-2 Propellant**
3. **Recovered JA-2 Propellant approved for Type Classified Round**
4. **Ready for Full Rate Production**

Recovered JA-2 Propellant Evaluation

- **Specific characteristics evaluated:**
  - **Chemical Properties**
  - **Propellant Stability**
  - **Inherent Energy (Closed Bomb Testing)**
- **Ballistics Testing of XM1028 cartridges:**
  - **Charge Establishment**
  - **Charge Verification and Lethality**

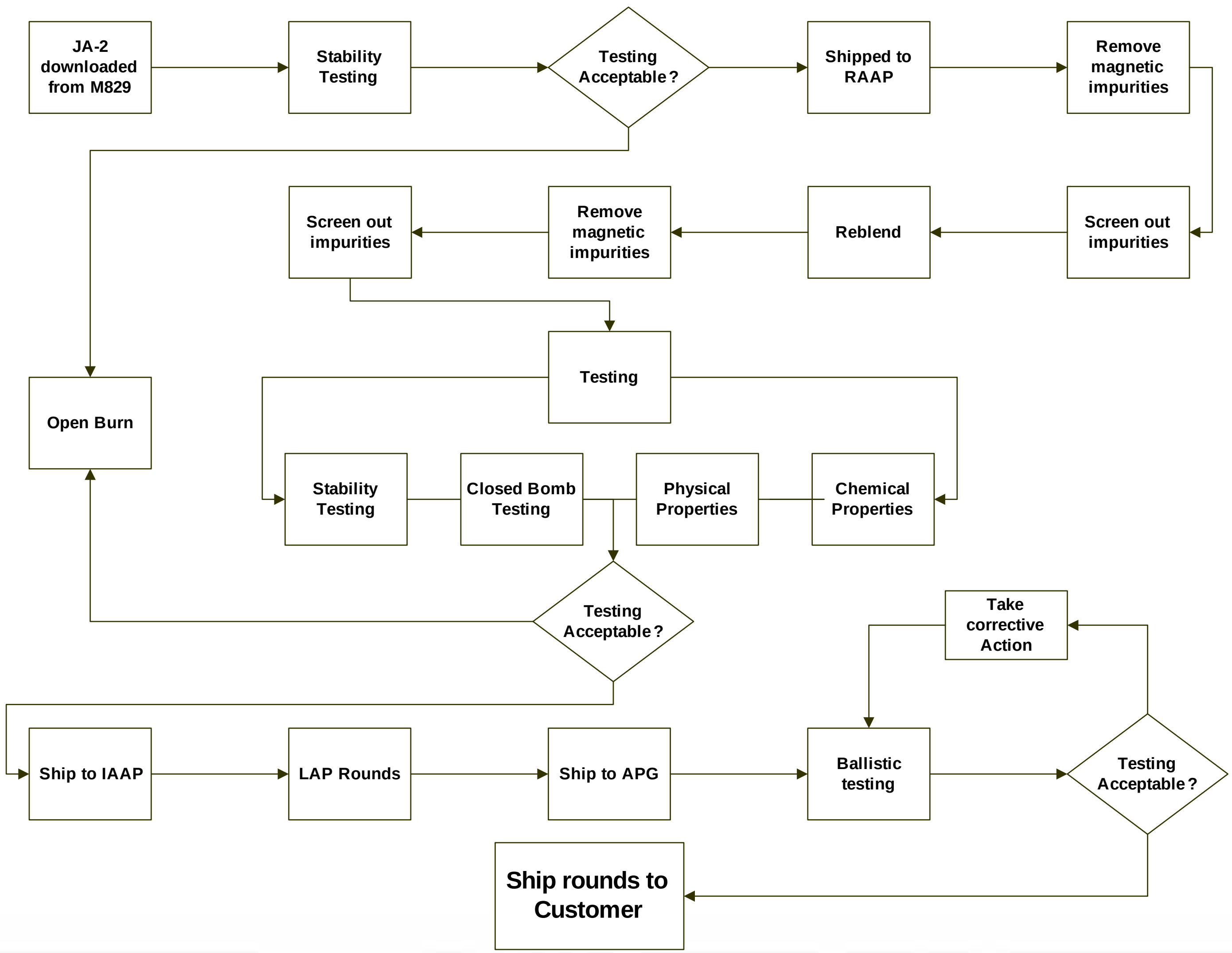
Recovered JA-2 passed all performance tests
Recovered JA-2 selected as the propellant solution

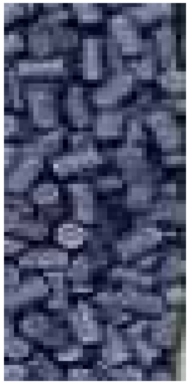
Compressed Development Through PY1

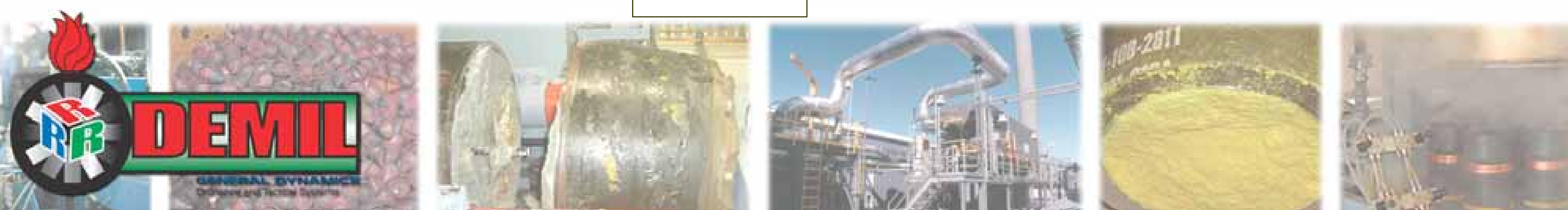


262,000 pounds of JA-2 reused through Dec 2005

Process Flow Developed for JA-2







JA-2 Individual Blended Lot Testing at RAAP

- **Characteristics evaluated by:**
  - **Chemical Properties**
    - **Chemical Composition**
  - **Physical Properties**
    - **Propellant Dimensions**
  - **Propellant Stability and Physical Tests**
    - **Heat Test and Fume Test**
  - **Inherent Energy (Closed Bomb Testing)**
    - **Relative Quickness And Relative Force**
  - **Hygroscopicity**

M1028 Production Phase

- **The Canister Round is currently fielded to the warfighter**
- **14,000 M1028 Canister Rounds produced through Dec 2005**
- **GD-OTS' Production Contract through 2008 will use approximately 544,000 lbs of recovered JA-2 Propellant to produce 34,000 rounds**
- **FMS Contract was Awarded for 3,700 rounds using 60,000 lbs of recovered JA-2 Propellant**

120mm M1028 **Propellant**

Benefits Summary

- Rapidly met urgent warfighter needs
  - Compressed development
  - Fielding time reduced

- Cost Savings
  - New propellant development cost eliminated
  - Propellant production cost reduced – 75%
  - Cost of OB/OD eliminated

- Environmental Benefits
  - No JA-2 OB/OD
  - No Pollution

Reuse - Looking Ahead

- Approximately 262,000 lbs of recovered JA-2 from un-fielded M829 rounds has been reused
- 588,000 lbs of JA-2 propellant available from fielded M829 rounds stored at IAAP
  - Condition of the propellant is unknown
  - Being evaluated and tested for reuse
  - Planned completion by Dec 06
- We are looking for more un-fielded JA-2 to be reused in M1028

GD-OTS Demil Team

QUESTIONS?

TOOELE ARMY DEPOT
Ammunition Equipment Division
(AED)

Small Arms Brass Recycling and Reclamation

Mr. Brent Hunt
(435) 833-5045
Brent.Hunt1@us.army.mil

Presented at:
2006 Global Demilitarization and Exhibition
1-5 May 2006

Small Arms Brass Recycling and Reclamation

Agenda

- Situation
- MPPEH
- Turn-In and Certification
- APE 1408 Safety Certification System
- Summary

Small Arms Brass Recycling and Reclamation

Situation

- Fired brass is a revenue generator
- Difficult to certify as free-of-explosive
- Requires QASAS certification before turn-in
  - Uncertified brass accumulates in ASP residue yards
- Regulatory requirements and processes are unclear across services

Material Potentially Presenting an Explosive Hazard (MPPEH)

- Equipment associated with munitions operations
  - *Production, demilitarization, disposal*
- Containers and packaging material
- Range-related debris
  - *Hard/Soft targets*
- Munitions debris remaining after use and demil
  - *Range residue*
  - *Washed-out/autoclaved munitions*
  - *Small arms brass*

Material Potentially Presenting an Explosive Hazard (MPPEH)

- **DoDI 4140.62**, *Management and Disposition of MPPEH*
- **DoD 6055.9-STD**, *DoD Ammunition and Explosives Safety Standards*, Ch. 16 – *MPPEH*
- **DoD 4160.21-M, Ch4, Para B3.**, *Defense Material Disposition Manual (AEDA)*
- **DoD 4160.21-M-1, App 4 Cat III**, *Defense Demilitarization Manual*
- **Army TB 700-4,** *Decon of Facilities and Equipment*
- **NAVSEA OP 5,** Ch. 13, Paragraph 15 change 4, *Material Potentially Presenting and Explosive Hazard*

Planning Range Management

Range Residue inspected in accordance with DoD 4160.21-M, Section 4B3 and DoD 6055.9-STD, Chapter 16.

Planning Range Management

DOD 6055.9-STD Chap 16 requires DoD Components shall take actions necessary to ensure transferred MPPEH is either (a) initially 100% inspected and independently 100% re-inspected or (b) processed by DDESB approved means and post-inspected (sampled). DDESB approved processing includes thermal treatment (flash burning).

Brass Turn-In and Certification

- Inspectors fill out DD Form 1348-1A, noting that material is inert/free of explosives
- Turn-in to either DRMO or Qualified Recycler Program (QRP)
  - *DRMO: segregate to size (demil OCONUS)*
  - *QRP: demil (crush, shred, etc.) [DoD 4160-21 M, chap 4, para B3.b.(5)(d)]*
- APE 1408 Safety Certification System assures brass is free of explosives

Ammunition Peculiar Equipment (APE)

- AR 700-20, TM 43-0001-47
- Maintenance, Surveillance, Demil, Resource Recovery and Recycling (R3)
- Loaned to Army installations on an as-needed basis
- Installations provide “bricks-and-mortar” support

APE 1408 Safety Certification System for Small Arms Brass

APE 1408 Safety Certification System for Small Arms Brass

- SPECIFICATIONS:
  - 1000 pounds per hour process rate, sizes .22 cal to .50 cal (Actual locations ~700 lbs/hr)
  - 1.5 MBTU Propane Burner
  - Available propane powered electric generator
- No explosive siting required [DoD STD 6055.9, para C5.5.21]
- Not a solid waste incinerator [40 CFR 261.4(a)(13)]

APE 1408 Safety Certification System for Small Arms Brass

- Eight APE 1408s in the inventory
- Currently fielded in six locations:
  1. Fort Lewis, WA
  2. Fort Hood, TX
  3. CASB, Okinawa, Japan
  4. CP Kwangsari, ROK
  5. Schofield Barracks, HI
  6. Picatinny Arsenal, NJ

Fort Lewis, WA

(I CORPS)

Ft. Hood, TX

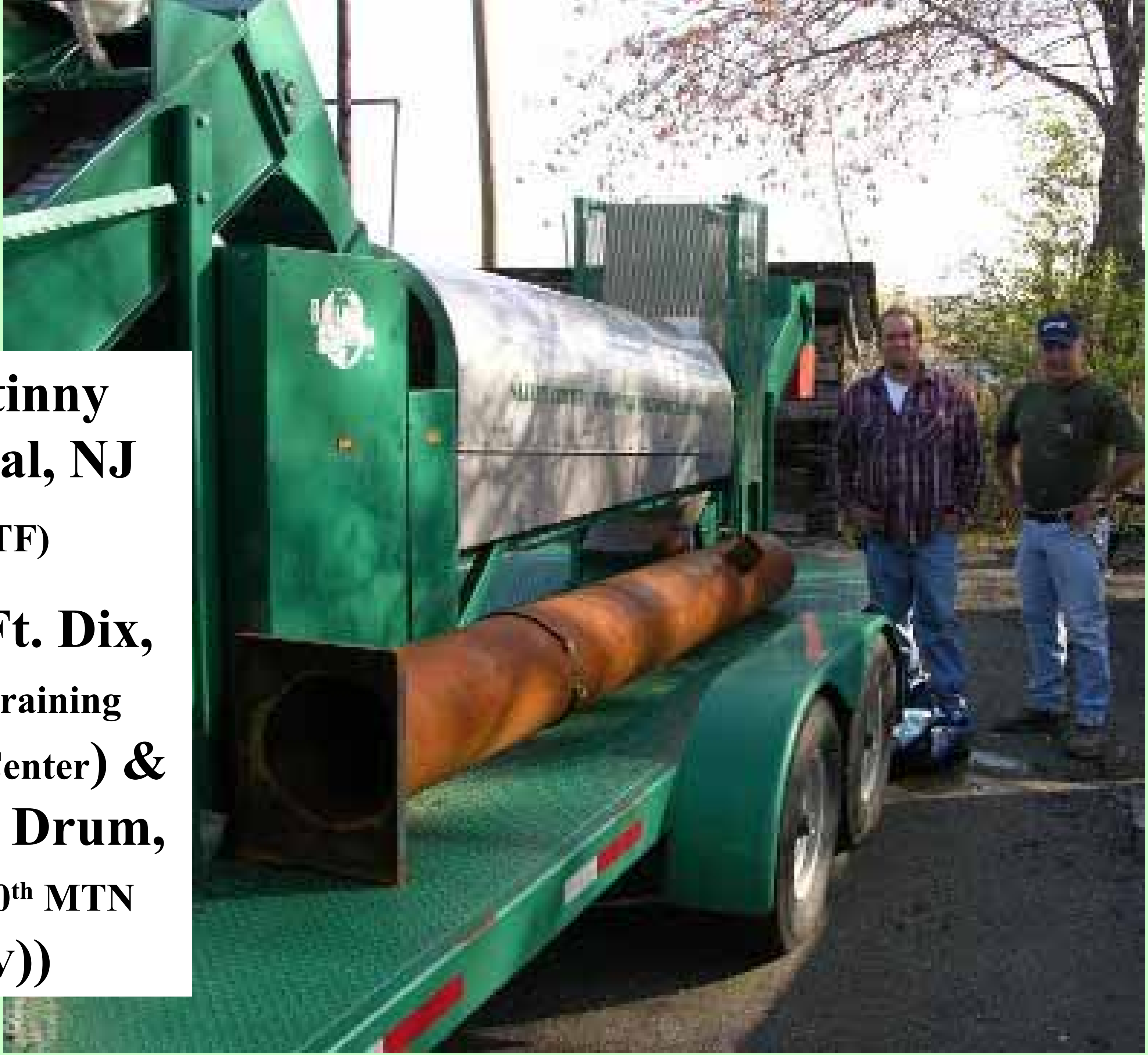
(III CORPS, 4th ID, 1st CAV DIV)

CASB, Kadena AFB, Okinawa, Japan

(83rd ORD BN)

Camp Kwangsari, Republic of Korea

(6^{th} ORD BN, 17^{th} ORD CO)



Picatinny Arsenal, NJ

(ATF)

(with Ft. Dix, NJ (Training Support Center) & and Ft. Drum, NY (10th MTN DIV))

Schofield Barracks, Hawai'i (25th ID)

APE 1408 Safety Certification System for Small Arms Brass

- Remaining APE 1408s to be fielded in:
  - Ft. Knox, KY
  - Ft. Sill, TX
- Customers for Outyears:
  - SWRO-IMA: Ft. Sam Houston, TX; Ft. Polk, LA; Ft. Irwin, CA
  - SERO-IMA: Ft. Bragg, NC; Ft. Campbell, KY; Ft. Jackson, SC; Ft. Rucker, AL; Ft. Stewart, GA; Redstone Arsenal, AL
  - Yakima, WA; Ft. Dix, NJ; Ft. Drum, NY, …

Summary

- MPPEH workgroup developing standardized processes
- Non-certified rounds build up in ASP residue yards
- The APE program is assisting ammunition supply points by supplying the APE 1408 Safety Certification System

Robotic Assembly of Three-Dimensional Heterogeneous MEMS Devices

James F. (Red) Jones, Brian A. Kast and James M. Bailar
redjone@sandia.gov

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Sandia's Interest in Assembled Microsystems

Microsystems offer lower mass and smaller volume system components which can provide enhanced capabilities for existing and future systems.

- **Fuses** (Low mass could mean high shock survivability, longer throw, improved accuracy, etc.)
- **Sensors** (Integrate into legacy systems, lower power, expanded capability, more covert, etc.)

System is a group of parts interacting to achieve a common function and typically can include components for:

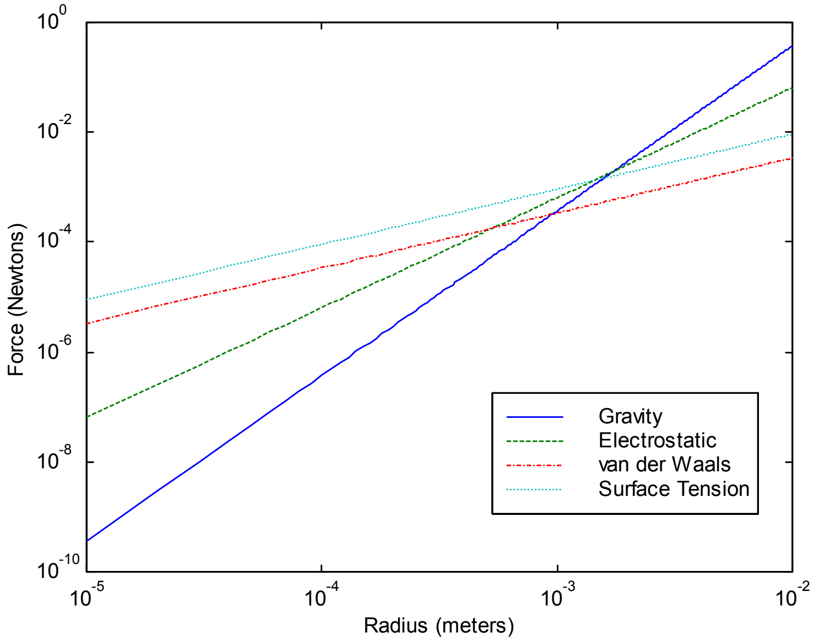
Power storage and/or transmission
Sensing, data storage, and/or data processing
Structure/packaging
Communication

Functional micro-Systems are comprised of a variety of parts fabricated using a variety of process and/or materials in order to meet required performance characteristics.

Typically, some assembly required….

Allen-Bradley 42EF Photoswitch®
Courtesy of Allen-Bradley

Issues with Pick & Place Micro Assembly



Forces of Attraction[1]

Manual manipulation of 100μm OD gear[2]

[1]John T. Feddema, Larry K. Warbe, William A. Johnson, Allison J Ogden, David L. Armor, "Assembly of LIGA using Electric Fields", SAND2002-1084 April 2002, p1.
[2]Courtesy of John Feddema, Sandia National Laboratories

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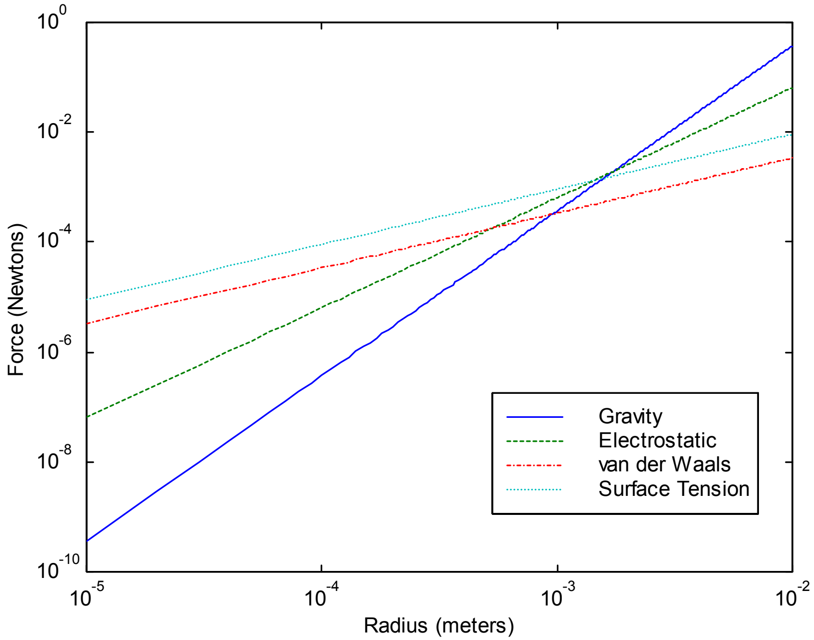

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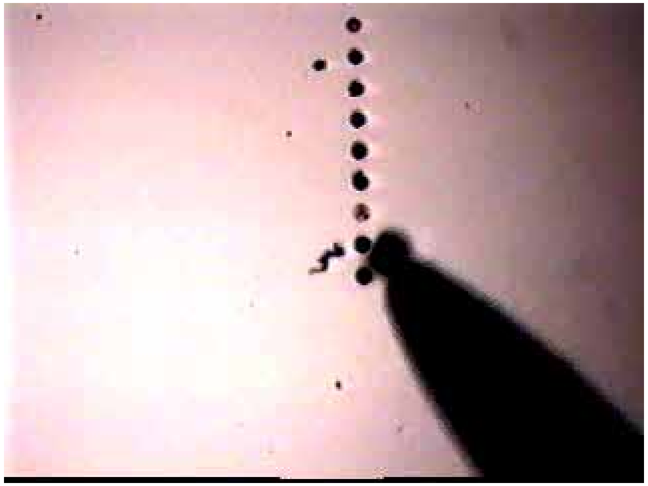

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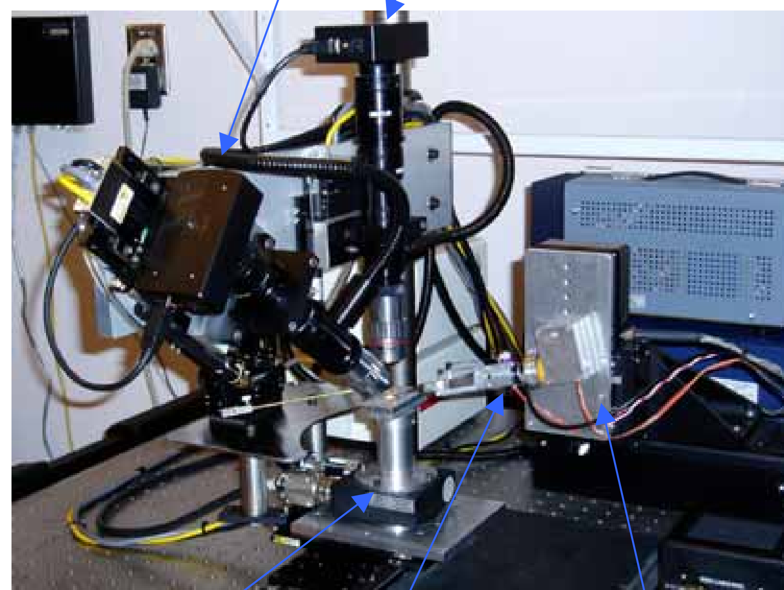
[2]Courtesy of John Feddema, Sandia National Laboratories

3D Operator Directed Micro Assembly

Permits rapid prototyping of complex assembled micro-systems in order to assess viability of concepts.

Provides a bases for developing economically viable production capability.

Operator Console with Phantom Haptic Interface



Oblique view camera & microscope

Rendering camera, microscope, & stage

Parts positioner (Parker- Daedal)

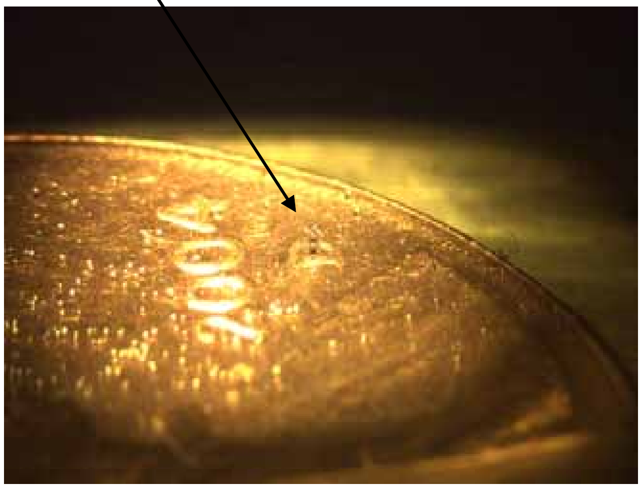
Actuated tweezers

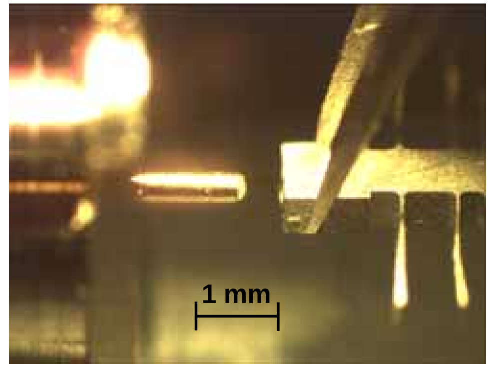
Tool manipulator (Adept)

Sandia National Laboratories

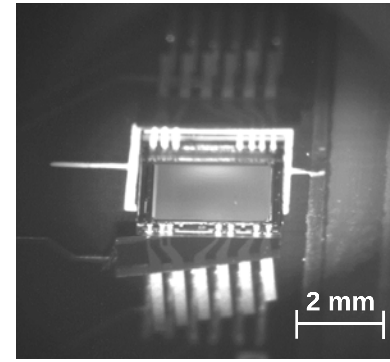
Assembled Devices

Humanoid

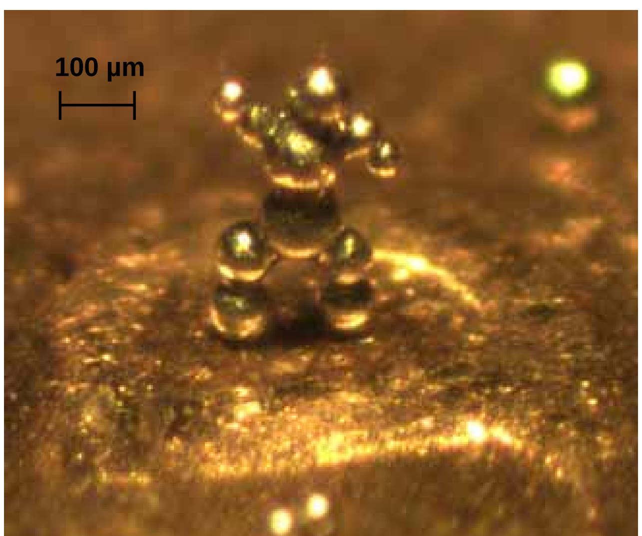




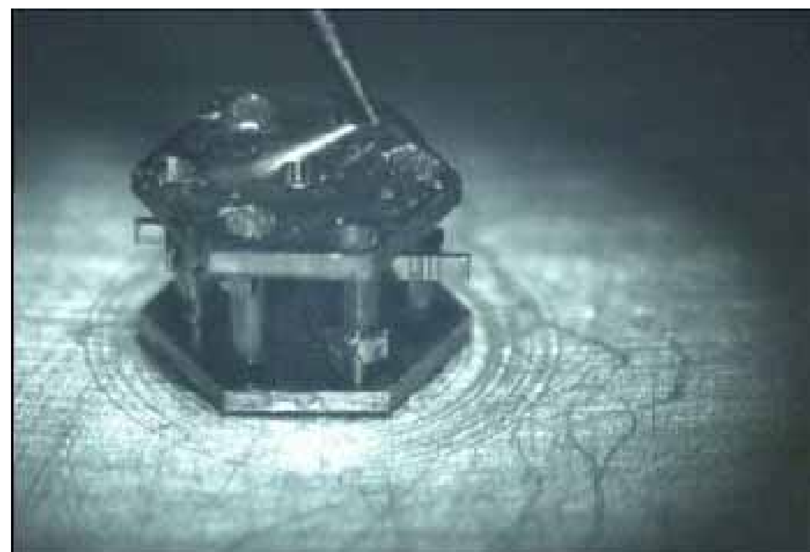
Meso-machined RF Relay



CCD Placement



Penny Guy



Pivot Bearing

1 mm

Sandia National Laboratories

3D Visualization

Resolution improves linearly with increasing numerical aperture
Depth of field decreases as a square of numerical aperture
Use image processing to synthetically generate 3D view[1]

- **Snap many images as objective lens moves**
- **Extract in focus portions of images**
- **Use images to render a 3D view**

Performance

- **~11 Hz rendered 3D images using PC technology**
- **~4 Hz using conventional CMOS cameras**

$$\text{Resolution} = \frac{0.61\lambda}{\text{NA}}$$

$$\text{Depth of Focus} \approx \frac{n\lambda}{(NA)^2}$$

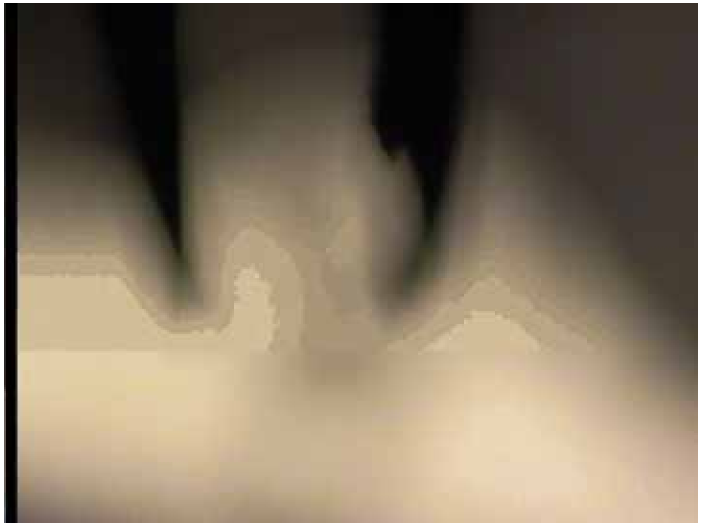
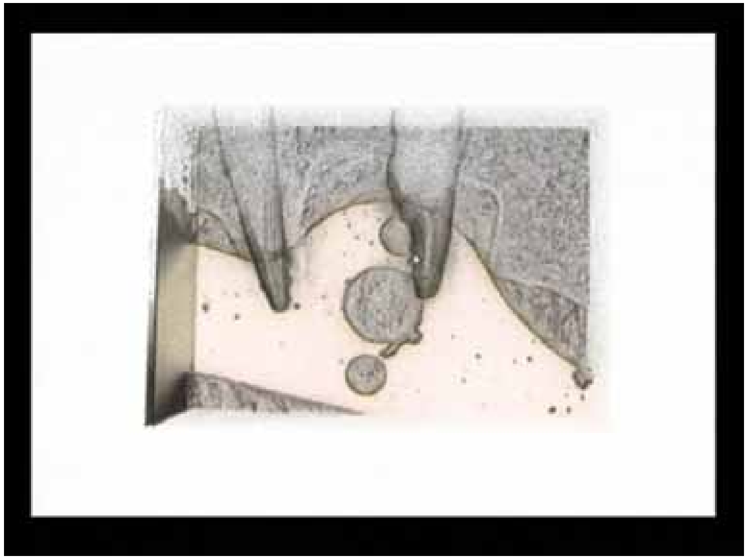


Image Sequence
(Tweezers above pawl)



3D Rendering
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[1] Greminger M.A. and Jones J.F., "Real-Time Three-Dimensional, Visualization of Standard Light Microscope Image Sequence for Microassembly", IEEE International Symposium on Assembly and Task Planning, Montreal, Canada, July 2005

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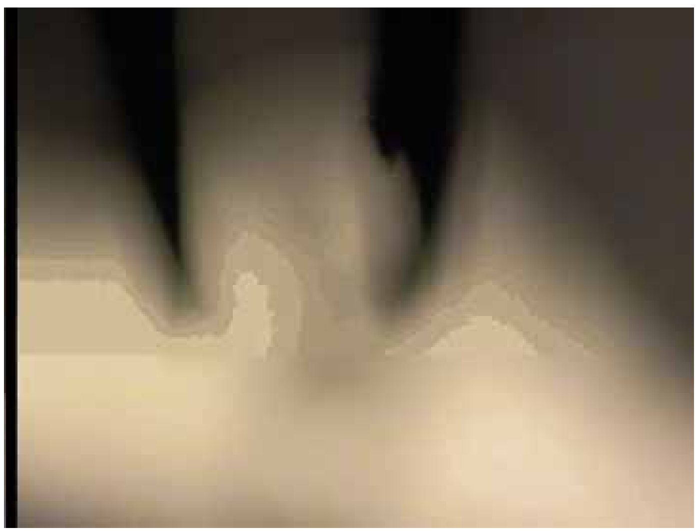

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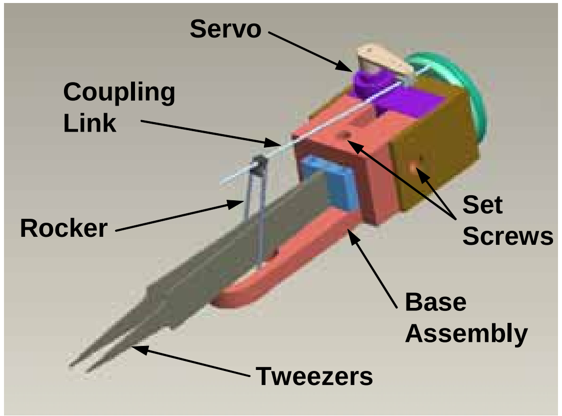
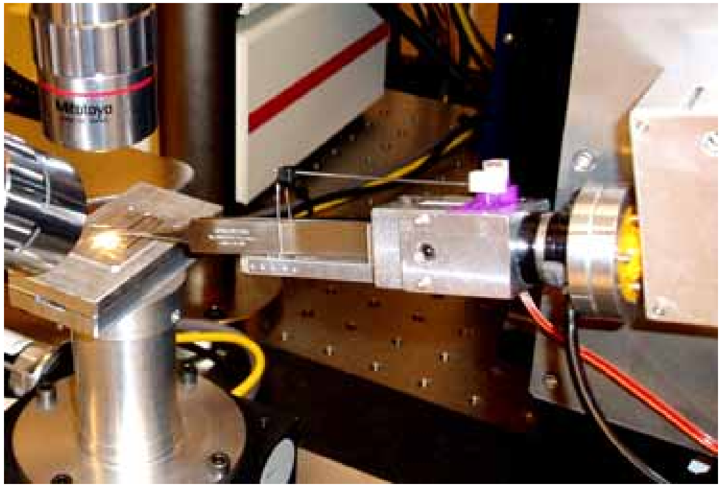
Grasping

Gripper consists of actuated precision tweezers

CAD Model





Actuated Tweezers with Integrated Loadcell

Tweezers performance releasing micro-scale metallic spheres (two titanium/one alloy)

Tweezers Manuf.	Sphere Material	Sphere Diameter (micron)	Release Speed	Percent Release
Optima	440 SS	83-86	Fast	100
Dumont*	Inconel	100	Fast	100
Optima	Inconel	95	Fast	95
Dumont	Inconel	107	Fast	95
Optima	440 SS	82-107	Slow	90
Optima	Inconel	95	Slow	85
Dumont	Inconel	105	Slow	75
Dumont	Inconel	100-104	Slow	45

* - Dumostar

Observations:

- **Release speed is the dominant criterion**
  - mass remains a significant parameter
- **440 SS has higher probability of release**
  - magnetism is likely not significant
- **Dumostar performed as well as titanium**
  - available in biological tips

Concluding Remarks

Have demonstrated the capability to assemble devices where individual components range from a few millimeters to tens of microns.

What have we learned?

- The universe is not always intuitive at the micro scale!!
- Human assembly of micro scale structures is not possible without “aids”.
- Pick & place micro assembly is possible using precision robotics coupled with advanced sensors, controls, and processes.

How does this fit into the Demil world?

- One possibility: Lifecycle sensor that determine when a munition should enter the Demil stockpile account
  - (e.g. missile propellant stability sensor system)

Waste Treatment Using Molten Salt Oxidation Technology

Tim Rivers

MSE Technology Applications, Inc.

14th Annual Global Demilitarization Symposium & Exhibition

Coauthors

- Dr. Solim Kwak, Eddie G. Ansell, Majid Moosavi,U.S. Army Defense Ammunition Center (DAC)
- Francis Sullivan, U.S. Army Armament Research, Development and Engineering Center (ARDEC)
- Joel Kallenberger, Blue Grass Army Depot (BGAD)

Program Sponsors

- Program Sponsor:
  - United States Defense Ammunition Center
- Contract Administered by:
  - Armament Research, Development and Engineering Center
    - Contract Number, W15QKN04-C-1092
  - Naval Surface Warfare Center-Crane
    - Contract Number, N00164-05-C-4721

Technology Background

- Molten salt oxidation (MSO) is a flameless oxidation process
- Operates at lower temperature than incineration
  - Approximately 800^0C
- Eutectic salt mixture captures acid gas elements
  - Na_2CO_3 and K_2CO_3 mixture

Process Chemistry

- Described at previous Global Demilitarization Symposiums
- Contaminants of concern
  - Simple organics (explosive, contaminated carbon)
    - $2C_aH_b + (2a + b/2)O_2 \rightarrow 2aCO_2 + bH_2O$
  - Nitrogen-bearing organic wastes
    - $C_aH_bN_c + O_2 \rightarrow CO_2 + H_2O + N_2 + NO_x$

Project Background

- MSE Technology Applications, Inc. was tasked to demonstrate MSO technology in the field
  - Package and ship existing pilot-scale MSO system installed at DAC in McAlester, Oklahoma, and install and demonstrate at BGAD in Richmond, Kentucky
  - Demonstration testing to focus on waste TNT destruction at BGAD.

Project Background (Cont'd)

- Also tasked to design and deliver prototype MSO system for energetic contaminated material and other waste streams at DEFAC facility in South Korea
- Optimized prototype system uses background information developed from pilot-scale system runs at DAC and BGAD

Pilot-Scale System

- Developed by Lawrence Livermore National Laboratory in 2001 and delivered to DAC
- Tested at DAC in 2002, moved to BGAD in 2004

Pilot-Scale Component Description

- 16-inch diameter reactor
- 17 individual external ceramic heaters

Offgas Treatment System Description

- Salt trap for capturing salt carryover
- Baghouse for initial particulate filtration
- High-efficiency particulate air (HEPA) filter for final particulate filtration
- Combined CO and NO_x reduction system
- Continuous emissions monitor
  - NO_x, SO_x, CO, CO_2, THC, and O_2

Demonstration Testing

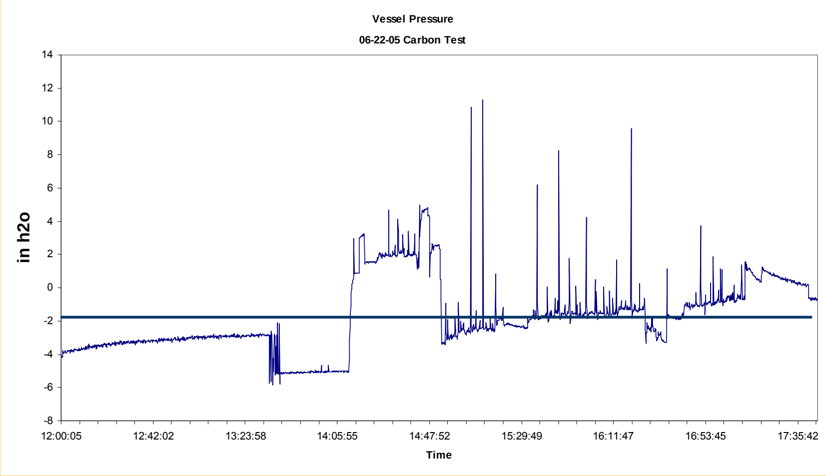
- A demonstration test was developed to:
  - Verify that TNT sludge can be safely ground for introduction into the MSO reactor
  - Test process operation of MSO reactor on TNT.

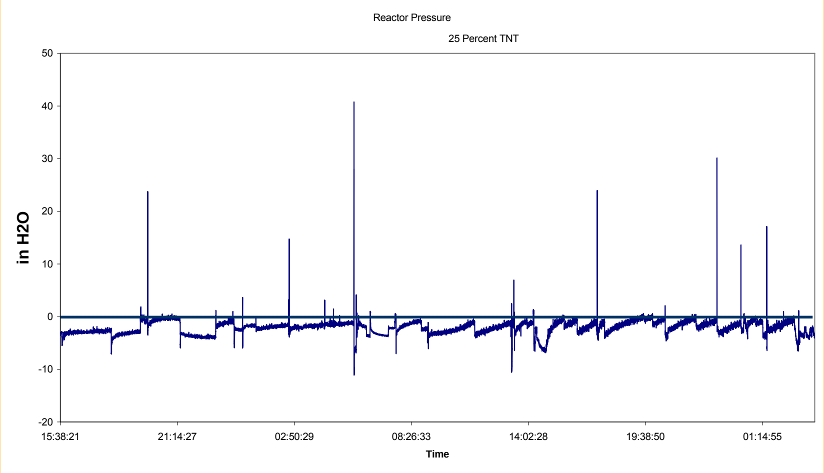
TNT Grinding

- Research was performed to understand if TNT could be safely introduced into grinder without a detonation
- Based on results of a Hazard Analysis, decided TNT could be ground with the following conditions
  - Sweco mills are low energy grinders
  - TNT/water slurry concentrations safe to handle
  - Grinder and Screen operated from remote location
- 25% TNT in a water slurry was introduced into a Sweco ball mill and safely processed into feed stock for the MSO reactor

TNT Processing

- Test plan was developed to demonstrate performance of MSO system
  - Operated up to 154 ml/min
  - Processed TNT for approximately 40 hours continuous
  - Safely processed feed stock without process excursions
  - Graphs show that TNT is easier to process than carbon based feed stocks





TNT Processing

- Testing successfully accomplished goals
- Testing was suspended when TNT slurry became to viscous to be pumped into MSO reactor
  - Test stopped about two hours earlier than planned
  - Caused by over agitation of feed stock

Large Scale Prototype System

Process Design Basis

- Designed to treat secondary wastes resulting from operations at DEFAC facility in Korea
  - Explosive, contaminated, activated carbon
  - Water treatment plant deionization resins
  - Synthetic oils
  - Approximately 2.5 times larger feedrate than pilot-scale system

Feed Preparation System Description

- Designed to grind feedstock to less than 100 mesh
- Continuous batch feed preparation system
- Ceramic ball mill with vibrating screen

Reactor System General Arrangement

Reactor Description

- 18 inch diameter reactor
- 120 inches high
- Single diameter throughout entire reactor length
- 19 resistance heaters
- Inconel 600 reactor body

Offgas System Description

- Combined offgas cooler/salt trap
- Process lines heat traced to decrease heat-up time and keep offgas above dew point

Offgas Treatment System

- Baghouse
  - High temperature bags
  - Automatic cleaning system
  - Insulated and heat-traced

Offgas Treatment System

- High Efficency Particulate Filter
  - HEPA filter
  - insulated

Offgas Treatment System

- NOx reduction System
  - Offgas reheater
  - CO catalyst
  - NOx catalyst
    - Ammonia injection

Offgas Treatment System

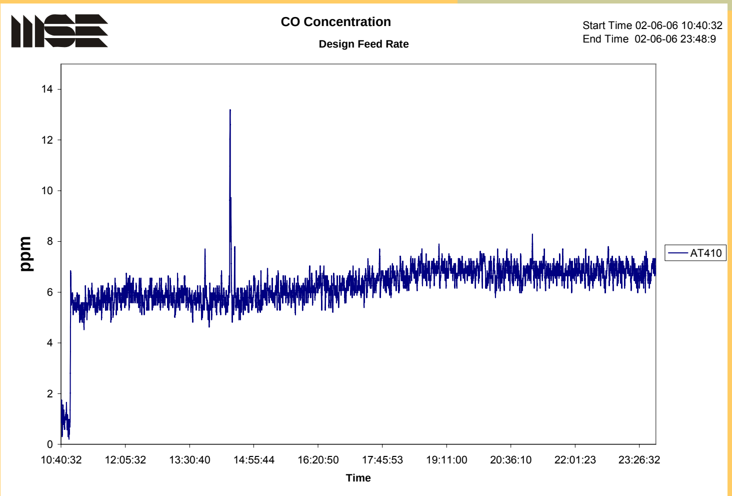
- Continuous Emissions Monitor
  - Heated probe
  - Automatic calibration
  - Multi analyzer
    - CO, CO2, O2, NO, NO2, SO2, THC, Ammonia

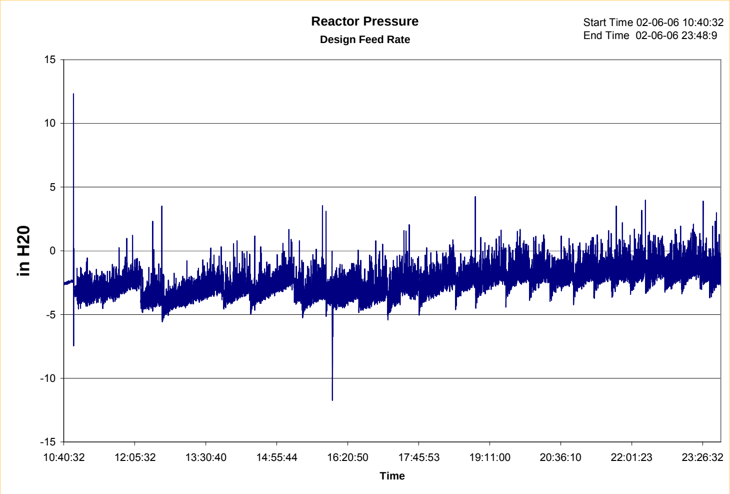
Demonstration Test Summary

- A demonstration test was run in February to define process parameters
- System ran approximately 120% of design basis using simulated feedstocks
- Premature failure of two heater elements caused system to be shutdown

Demonstration Test Summary

- Operated approximately 38 hours at design conditions
- Carbon Monoxide concentrations remained well below emission limits throughout test
- Reactor pressure maintained below atmospheric majority of test





DEFAC MSO Project Status

- Performing system optimization tasks through June
  - Replacing resistance heaters
  - Modifying feed system for maintenance issues
  - Addressing salt precipitation in reactor exit offgas piping
- Will perform duration testing and training through summer 2006

Summary

- Successfully ground and treated waste TNT slurry through pilot scale MSO system at BGAD
- Installed and performed checkout testing on production prototype MSO system at DAC
- Questions

Propellant Stabilizers Analysis by Thin-Layer Chromatography (TLC)

The Fielding Process

Rich Whipple, Greg Klunder, Peter Nunes,
Marina Chiarappa-Zucca

Global Demilitarization Symposium
Indianapolis, Indiana
May, 2006

Lawrence Livermore National Laboratory

Agenda

TLC for Field Analysis

- Propellants
- Explosives

TLC Propellant Stability Analysis

– How We Got Here

Transition from Lab to the Field

Propellant Stability is Related to % Remaining Effective Stabilizer (%RES)

Category	% Remaining Stabilizer	Stabilizer Loss
A	≥ 0.30	Acceptable
C	0.20-0.29	Significant
D	< 0.20	Unacceptable

1.

%RES = Virgin stabilizer
+ major daughter products:

DPA

DPA
2 NDPA (2N)
NNO DPA [2] (NNO)
4 NDPA (4)
2,4 DNDPA (2,4)
2,2' DNDPA (2,2')
2,4' DNDPA (2,4')
4,4' DNDPA (4,4')

2—NDPA

2—NDPA
2,4 DNDPA (2,4)
2,2' DNDPA (2,2')
2,4' DNDPA (2,4')

%RES for
Akardite II & Ethyl Centralite = remaining virgin stabilizer

1. Propellant Management Guide, 4th Ed., 2003
2. Not used in calculation of %RES by Army

Validation Test Results - Summary

Cutoff Values	Prop. Man. Guide[1]	HPLC	TLC
Cat A	≥0.30	> 0.35	0.45
Cat C	0.20-0.29	0.20-0.29	
Cat D	<0.20	<0.20	

Category by Method			
HLPC	TLC	Outcome	
A	A	True Negative	(TN)
A	C	False Positive	(FP)
C	A	False Negative	(FN)
C	C	True Positive	(TP)

Lots Analyzed by Stabilizer Type	
DPA	10
EC	7
AKII	2

- **Total Number of Lots Analyzed – 76**
- **HPLC Cutoff = 0.35 %RES**
- **TLC %RES Cutoff values**

TLC %RES Cutoff values	0.35	0.4	0.45
# FN	7	2	0
# FP	7	16	22
# TP	9	14	16
# TN	53	44	38
Sensitivity	0.56	0.88	1.00
Selectivity	0.88	0.73	0.63

(Sensitivity = TN/(TN + FP))
(Selectivity = TP/(TP + FN))

Expanding Capabilities

- **High Throughput Screening for Propellant Stability**

  Pre-Screen for strong Cat A

  Unknowns

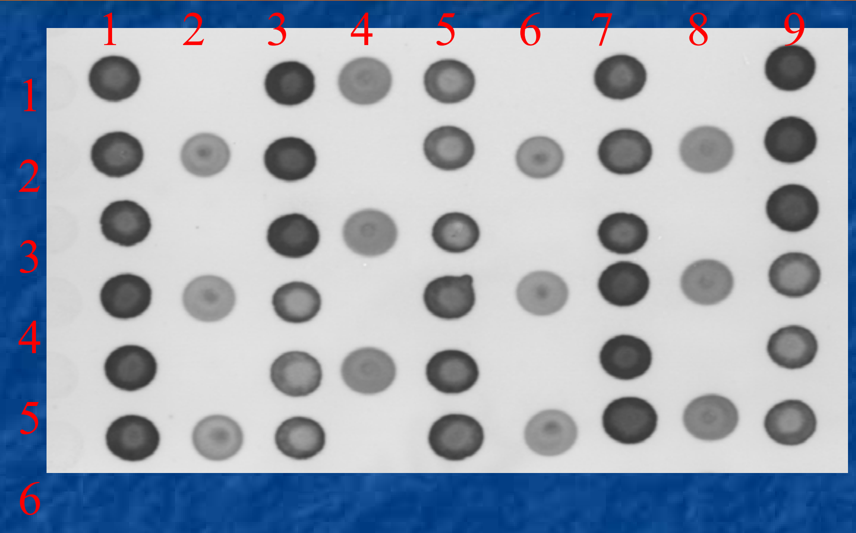
- **TLC analysis of Explosives**

  Bulk & Trace analysis

  IED

High Throughput Screening for Propellant Stability

- Rapidly screen 50 propellant samples
- Each spot contains all the components in the standard
- Determine strong Category A's
- Samples prepared for TLC analysis
- Spotted and colored with no separation
- Uses same software and camera



Integrated Intensity (%)

File Show Update Help

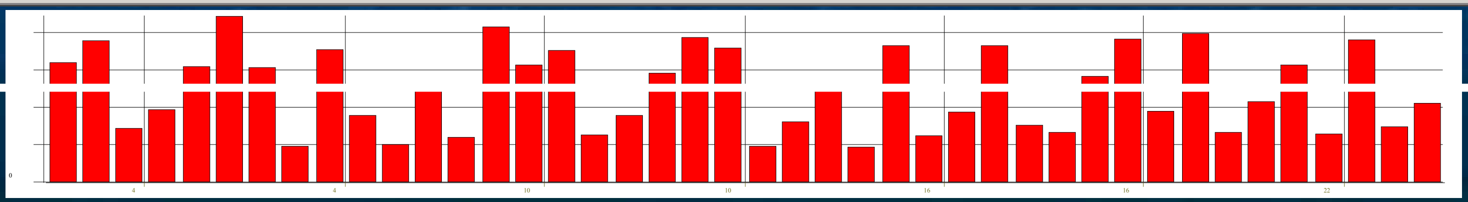
Max: 4424.8459

Min: 945.75030

Mean: 2465.0879

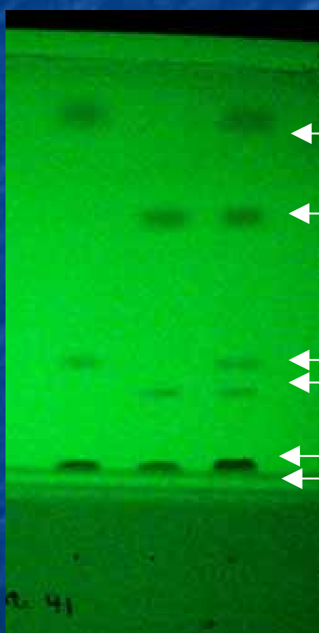
Std. Dev.: 1073.0416

\Col Row	1	2	3	4	5	6	7	8	9
1	100.0		118.3	44.7	60.4		96.1		137.9
2	100.0	31.8	115.6		58.3	32.8	85.4	39.3	135.5
3	100.0		112.4	40.6	57.3		93.4		123.7
4	100.0	26.8	45.2		69.1	26.3	101.9	34.8	51.10
5	100.0		41.6	36.5	77.3		104.3		52.1
6	100.0	33.6	54.5		78.7	32.2	95.9	37.5	53.1



TLC Analysis of Explosives

TLC Plate: Normal Phase
Visualization: Fluorescence quenching, UV (254nm) excitation

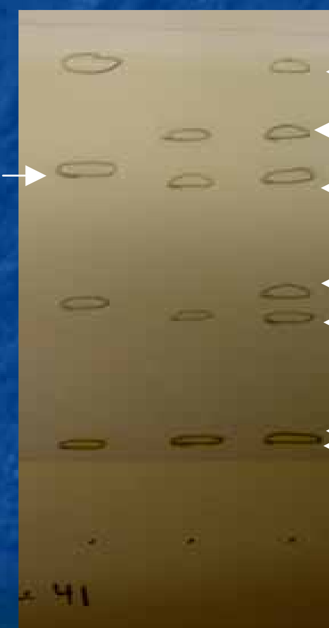


TNT
Tetryl
RDX
HMX
Picric Acid
Explosive D

After treatment

with DPA/Hexane sol’n

NG



TNT
PETN
Tetryl
RDX
HMX
Picric Acid
Explosive D

NG and Tetryl overlap, but can be Differentiated based on UV activity.

TLC Project – How We Got Here

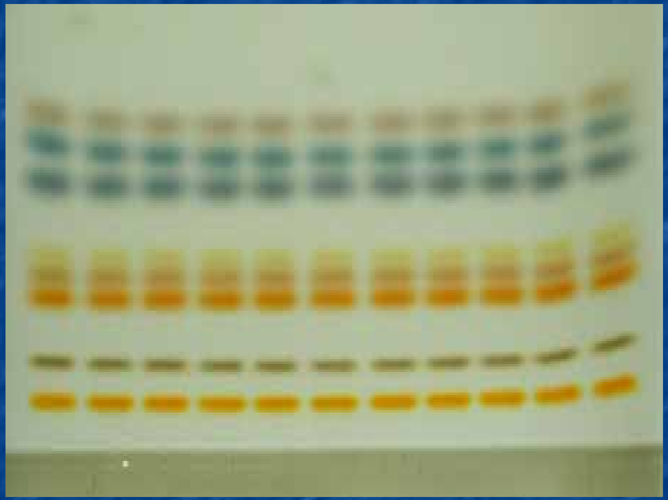
Project Inception -- 1996

- R & D Effort to Develop TLC for Propellant Stability
- From Screening to Quantification
- Fieldable Kit Development
- Validation Trips – *2000*, 2002
- Validation testing – 2004
- Validation Granted – 11/04
- Transition to the Field - 2006

2N
NNO
DPA

2,4
2,2'
2,4'

4
4,4'



Transition to the Field

- Training
  - Operators and Trainers
  - Mobile Analysis Teams - MAT
- Commercialization
  - Manufacturer – Pelatron Inc.
  - Marketing - PIKA International
- Locations
  - Tooele, Utah
  - Yuma, White Sands, or Aberdeen

Transition to the Field-cont

- Transition process
  - Complete reviews
    - Documentation
    - Safety
    - Wastes
      - Hazardous
      - Non-Hazardous
  - Supply and Distribution
    - Logistics
    - Shelf Life Issues

Propellant Analysis Toolbox

	HPLC	APE 1995	TLC
Overall Process	Involved	Simple	Moderate
Field Portable	No	Yes	Yes
Cutoff % RES	0.35	0.35 EC/AK 0.45 DPA/2NDPA	0.35 EC/AK 0.45 DPA/2NDPA
Propellant Types	All	Library	All
Waste	Yes	No	Yes
General Comments	Gold Standard	Known Propellants	Both Known and Unknown Propellants

Conclusion

- TLC is Validated for Propellant Stability analysis of most Stabilizer Types
- Demonstrated Expanded Capabilities
- Final stages of transitioning TLC to the field

Acknowledgements

Defense Ammunition Center

Picatinny Arsenal

Pelatron Inc.

PIKA International Inc.

14th Annual Global Demilitarization Symposium & Exhibition

Point-of-Application Microfluidic Synthesis of Sensitive Explosive

SAND2006-2233C

K. Wally*, M. Bartsch, S. Ferko,
Sandia National Laboratories
Livermore, CA

*kwally@sandia.gov

Sandia National Laboratories

Point-of-Application MicroFluidic Synthesis

- **Increase safety by synthesizing and purifying lead azide at the point of application**
  - **Bulk explosive would no longer be stored or transported in large quantities**
  - **Two less-hazardous chemicals, sodium azide and lead nitrate, mix to form a lead azide precipitate**
  - **Use microfluidics to improve process safety and produce consistent product quality**

Microfluidic Crystallization Systems

- **Microfluidic systems can offer a high degree of control over crystal size and uniformity**
- **A Microchannels' efficient heat transfer provides means for temperature control, (e.g., to control exothermic reactions)**

Examples from the Literature of crystal production in microchannels:

Microfluidic systems can produce inorganic crystals in continuous-reaction mode:

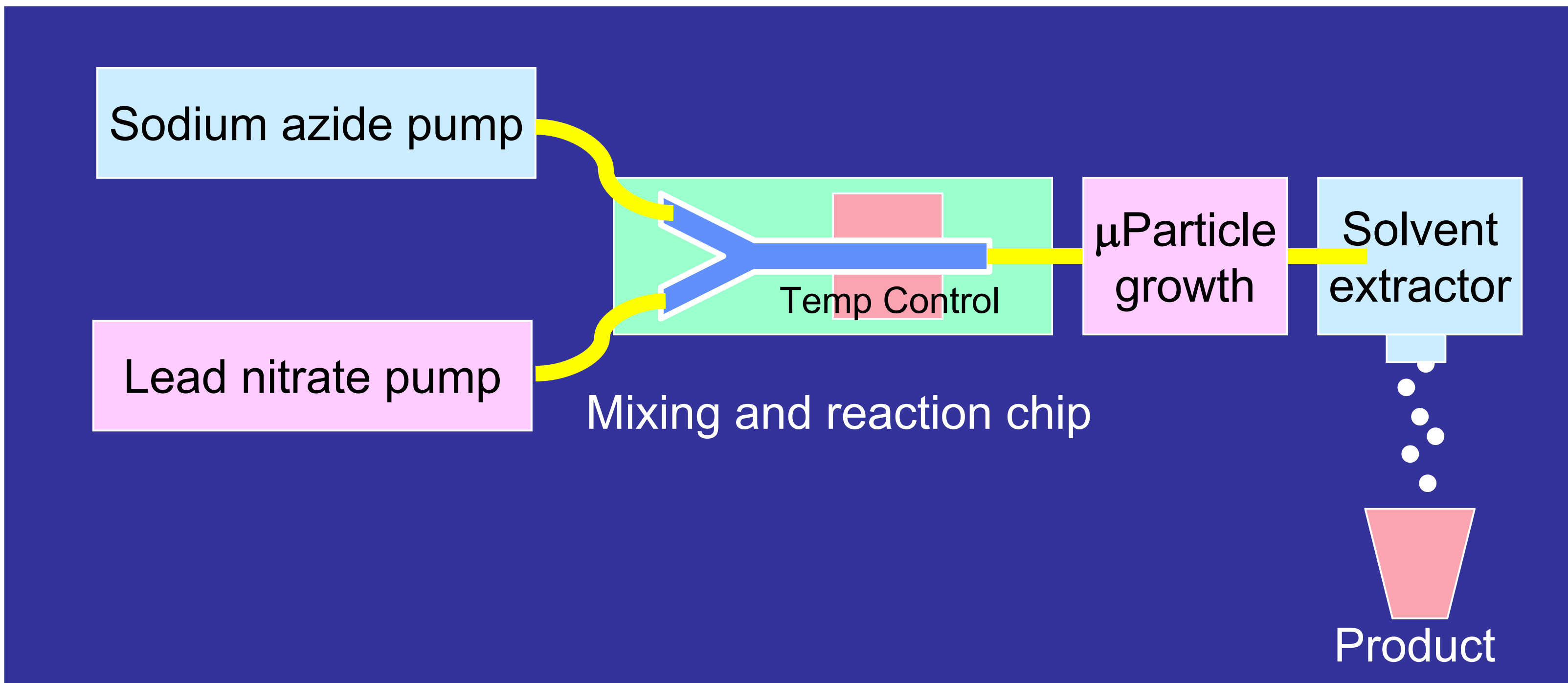
Continuous synthesis of CdSe–ZnS composite nanoparticles in a microfluidic reactor, Hongzhi Wang *et al*. Chem. Commun., 2004, (1), 48 - 49

Membrane-free fuel cell on chip generates carbonate crystal byproduct that is flushed:

Microfluidic fuel cell based on laminar flow,
E.R. Choban *et al.*, Journal of Power Sources, 2004

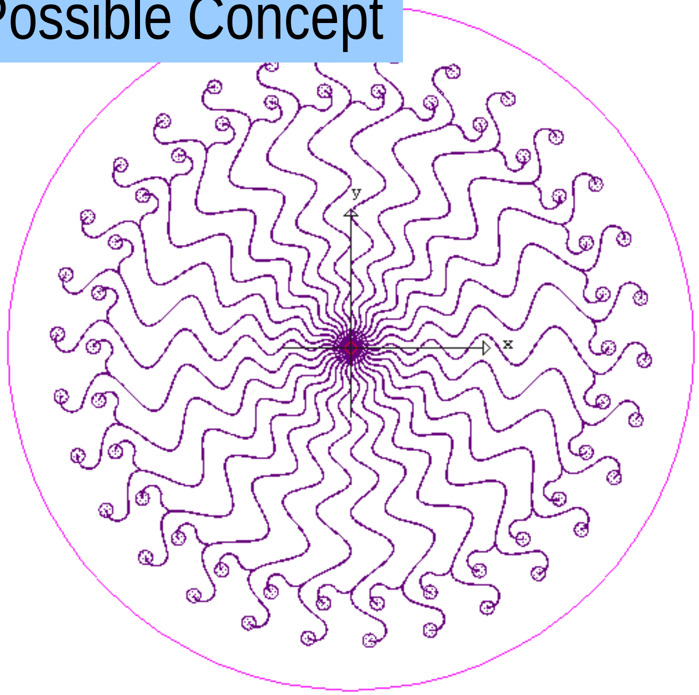
Microfluidic Lead Azide Reactor

Basic Conceptual System: reagent reservoirs, reagent pumps, a mixing/reacting crystallization channel having a temperature-controlled reaction zone, and a microparticle growth chamber, and particle separation/solvent extraction chamber



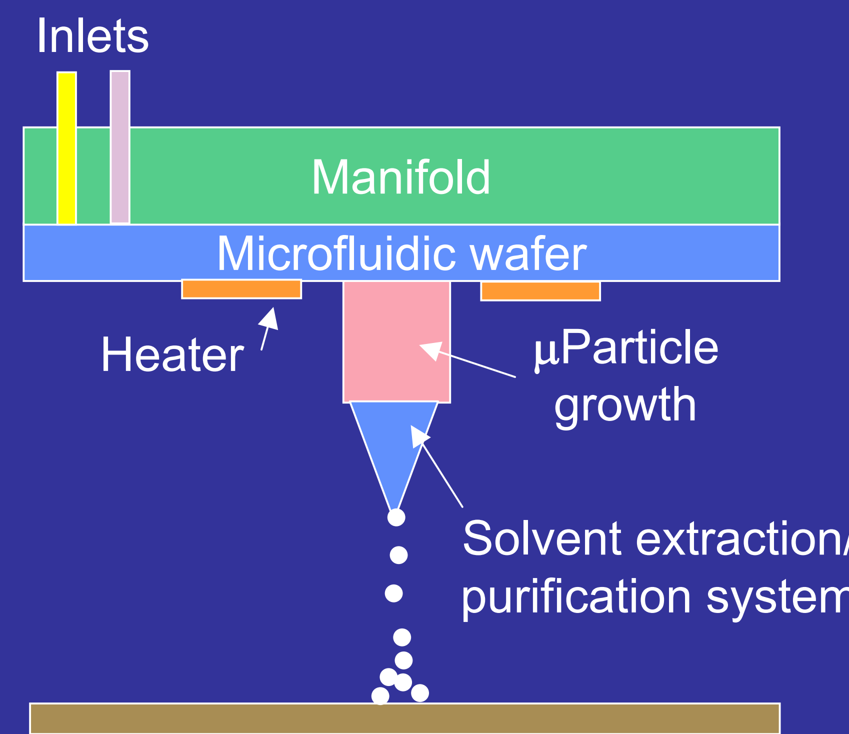
Use Microreactors in Parallel for Higher Throughput

One Possible Concept



- 30 10-cm mixing channels on a 4-inch wafer bring reaction products to a central port
- Reagents are distributed to inner and outer rings by a manifold

Side view



The 30-channel wafer will mix ~2 ml of reagents per minute

Point-of-Application Microfluidic Synthesis of Sensitive Explosive

Goal	• Reduce Primary Explosives Inventory and Minimize Primary Explosives Handling through Point of Application Microfluidic Synthesis of Sensitive Explosive		
Objectives	<u>Point of Application</u> • Integrated Apparatus • yield ~ 1 gram/min	<u>Synthesis of</u> • stable, dextrinated particles, • ~ 40 μm spherical diameter	<u>Sensitive Explosive</u> • Lead Azide • other primary explosives possible? (lead styphnate?)
Challenges	• microreactors require massively parallel output to achieve quantity • PofA requires insitu characterization to check/confirm proper function • applications require dry, flowing microparticles; must separate particles from liquids	• all crystallization occurs at nanoscale; particles must be grown to microscale & dextrinated for compatibility w/ existing uses • requires rapid growth and minimal inventory for Point of Application use • avoid sensitive needle crystals	• lead azide is explosive (extremely sensitive); azide is reactive (HN3, metal azides) and toxic
Approaches	• use microchannel sheet reactor for massively parallel output • use dielectrophoresis to concentrate, sort particles • use laser diode-based optical techniques for characterization	• Separate crystallization from crystal growth; optimize for each • Crystallize nanoparticles in microreactor for maximum control of concentrations, mixing, temperature, pH, dextrin additive, etc. • Use surrogate crystals for ease, speed, scope	• Use microfluidic reactor to minimize hazardous inventory • Optimize chemistry/conditions for stable particles • Destroy azide for safe shutdown, cleaning; (ceric sulphate?)
Tasking	• Microfluidic system integration for point of application synthesis; incorporate synthesis capacity, laser diode-based insitu characterization, and particle separations	• Develop synthesis process and micro apparatus using surrogate crystals	• develop lead azide-specific processes and optimizations

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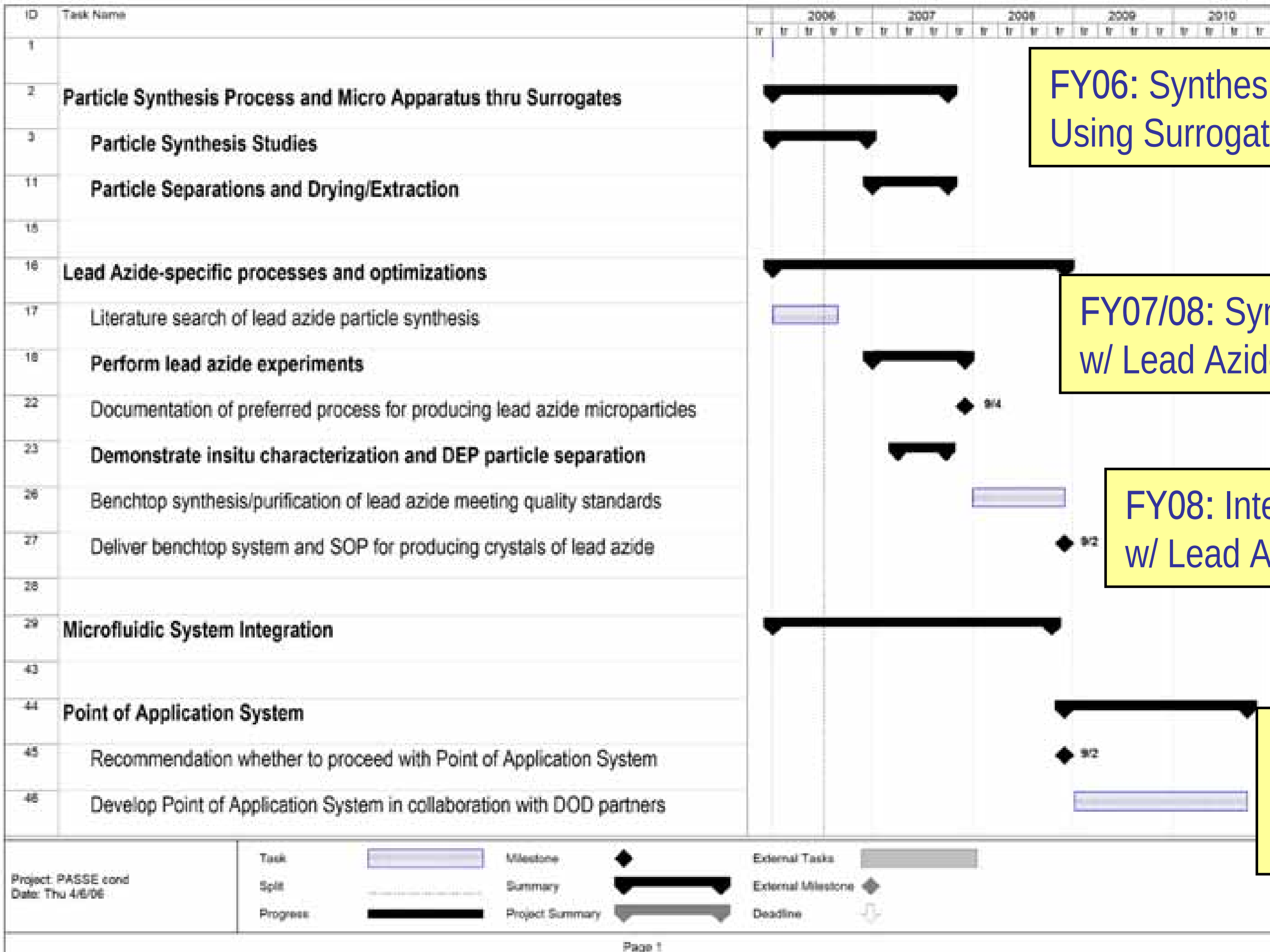
Microfluidic Synthesis of Lead Azide - Project Schedule -



FY06: Synthesis Process Dev. Using Surrogate Crystals

FY07/08: Synthesis Dev. w/ Lead Azide

FY08: Integrated System Dev. w/ Lead Azide

FY09/10: Decision to Build a Prototype PASSE System

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Develop Synthesis Process and Micro Apparatus using Surrogate Crystals

Point of Application Microfluidic Synthesis of Sensitive Explosive

Objective

Establish efficacy of proposed processes; optimize apparatus and process parameters for best generic operation:

Study mixing schemes and geometries for best nanoparticle crystallization;

Optimize processes for dextrination and particle growth

Develop particle separations, solvent extraction

Develop insitu characterizations

Basis

Microfluidic crystallization of nanoparticles is a relatively new, small, but growing research area.

Sandia has extensive experience and capability in microfluidic chemical systems and apparatus from microChemLab, Biobriefcase, etc.

Impact

Demonstrates the efficacy of processes and micro apparatus in achieving synthesis of preferred particles

Defines processes and apparatus to be used in lead azide-specific development task; important for Institutional Issues.

Establishes processes and apparatus to be carried into Integrated, scaled-up Point of Application apparatus.

Deliverables/Schedule

Process and micro apparatus to crystallize surrogate inorganic nanoparticles, and to grow them into dextrinated microparticles; Demonstration of the process and apparatus for one or more surrogate crystals; with sufficient parametric study to select preferred parameters suggestive of optimization.

Milestones

9/06 Demonstrate controlled crystallization of surrogates

4/07 Demonstrate controlled growth of surrogates to preferred particle size

7/07 Demonstrate insitu characterization; particle separations

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Lead Azide-Specific Processes and Optimizations

Point of Application Microfluidic Synthesis of Sensitive Explosive

Objective

Demonstrate proposed microfluidic reactor processes and micro apparatus with lead azide; Alter proposed processes and apparatus to accommodate specific requirements of lead azide.

Incorporate lead azide specific features; e.g. azide destruction system (ceric sulphate?) for safe shutdown.

Demonstrate compatibility of laser diode-based insitu characterizations; compatibility of DEP E fields to lead azide particles

Basis

Sandia chemistry expertise and applied expertise in energetic materials. (SNL/NM, SNL/CA)

Sandia/CA experience with energetic microfluidic systems, e.g. microthrusters (EK-pumped monopropellants and hypergolic propellants)

Sandia/CA test cell facilities for containment of small quantities of energetic materials, up to 2 lbs. of TNT eqv.

Impact

Demonstrates the efficacy of processes and micro apparatus in achieving synthesis of preferred particles of lead azide

Establishes processes and apparatus to be carried into Integrated, scaled-up Point of Application apparatus.

Deliverables/Schedule

Process and micro apparatus to crystallize lead azide nanoparticles, and to grow them into dextrinated microparticles;

Milestones

10/06 Begin experiments with lead azide
02/07 Demonstrate azide destruction system
03/07 Demonstrate first crystallization of lead azide
06/07 Demonstrate compatibility of characterization, DEP
03/08 Demonstrate controlled growth of lead azide to preferred particle size

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Microfluidic system integration

Point of Application Microfluidic Synthesis of Sensitive Explosive

Objective

Develop key technologies needed to effectively scale-up particle production to point of application quantities:
• microchannel sheet microreactors
• particle dextrination and growth microreactors
• series interconnections of one sequential process path
• parallel interconnection of two subsystems for capacity
• develop particle separations (Dielectrophoresis or other)
• integration of insitu characterizations

Basis

Sandia has extensive experience and capability in fabrication and integration of microfluidic chemical systems and apparatus from microChemLab, Biobriefcase, etc.

Impact

Demonstrates key technologies enabling scale-up of synthesis to point of application quantities;

Defines processes and apparatus to be used in lead azide-specific development task;

Provides a laboratory benchtop prototype microfluidic system to facilitate technology transfer to DoD partners

Provides technical basis for decisions to proceed with the engineering and production of a full-scale Point of Application Apparatus

Deliverables/Schedule

Laboratory benchtop prototype microfluidic system and operating procedure for synthesizing dextrinated lead azide microparticles; Preliminary Design for a Point of Application system. Recommendation/Decision whether to continue toward Point of Application-scale Engineering.

Milestones

05/07 Demonstrate microchannel sheet reactor;
07/07 Demonstrate integrated synthesis of microparticles
03/08 Demonstrate integrated insitu characterization
07/08 Demonstrate integrated particle separations, extraction
09/08 Demonstrate laboratory benchtop prototype for lead azide

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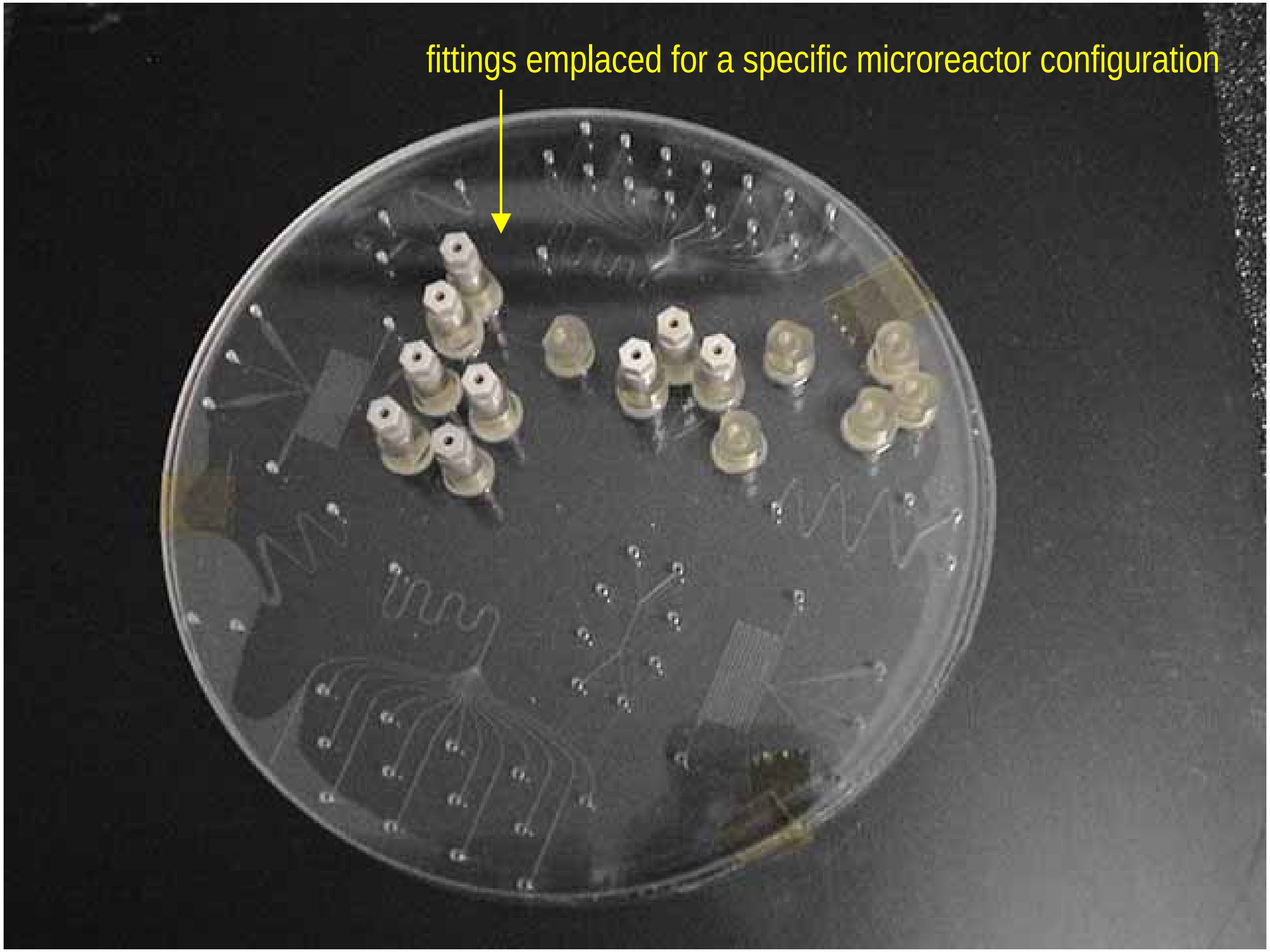
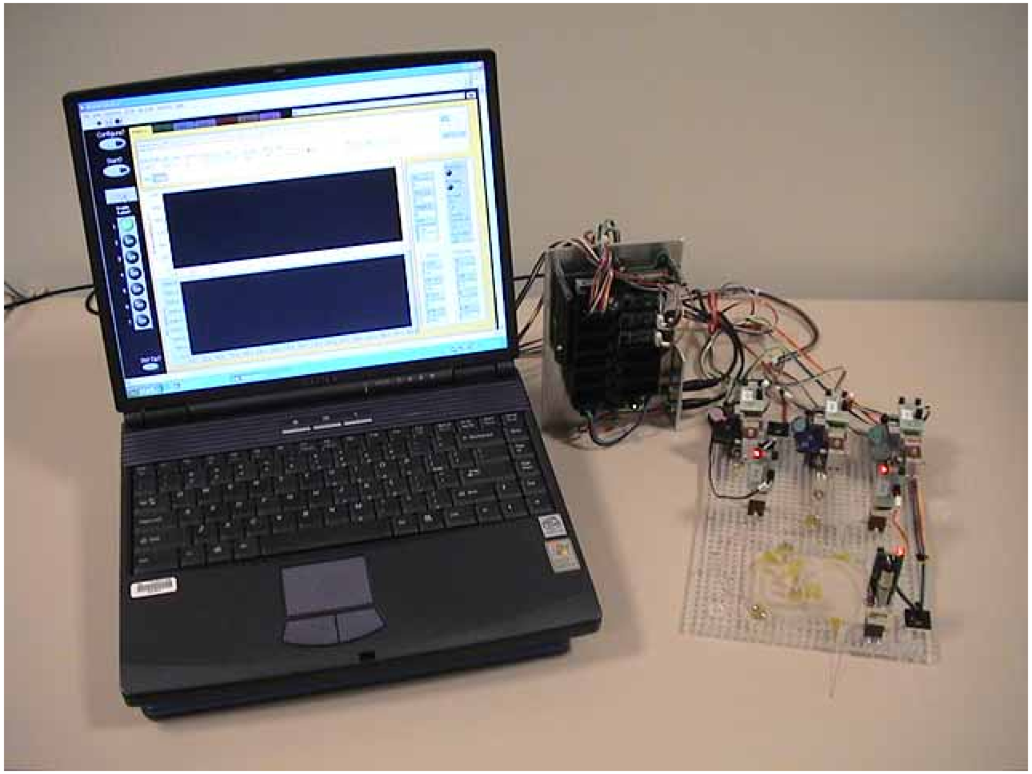
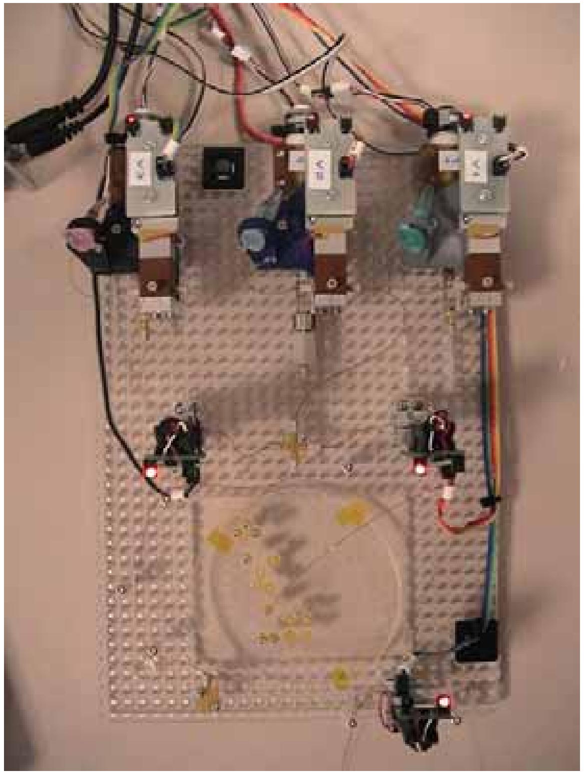
Various Microreactor Designs Can Be Explored for Mixing and Crystallization Performance



Borrowed Support Components Facilitate Our Microfluidic System Development

This initial microfluidic crystallization reactor system has been built up using pumps, valves, controllers, and fittings developed for Sandia's microChemLab and BioBriefcase projects.





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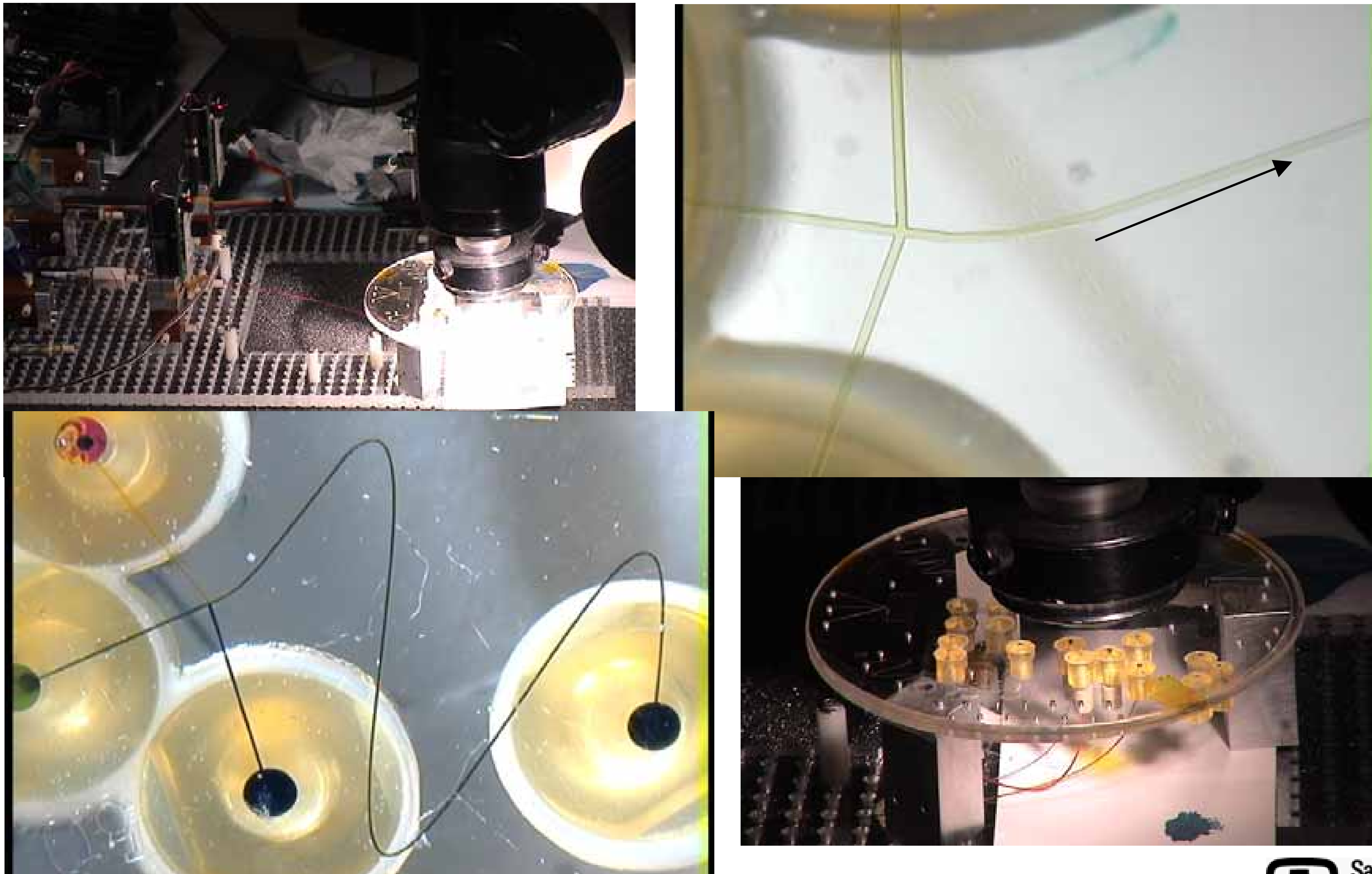
We've Begun Flow and Mixing Experiments Using a Microfluidic Crystallization Reactor



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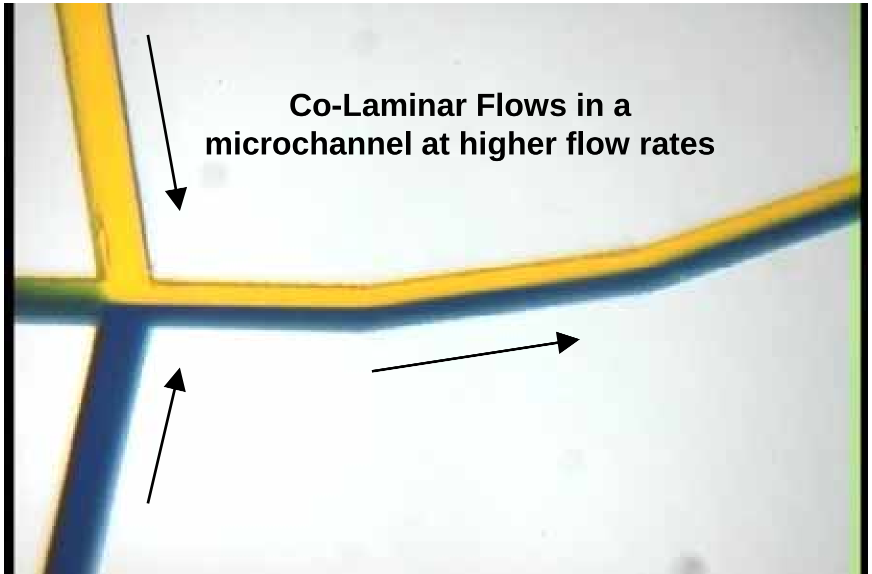
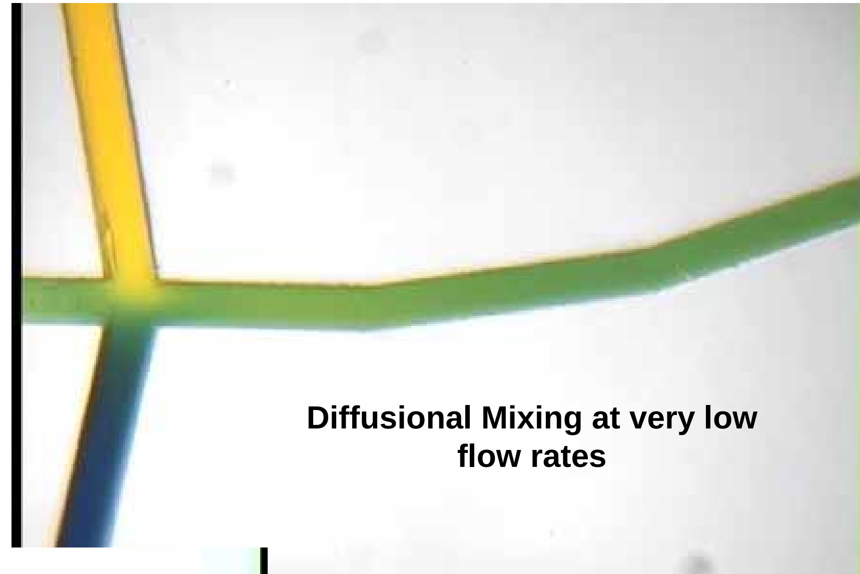
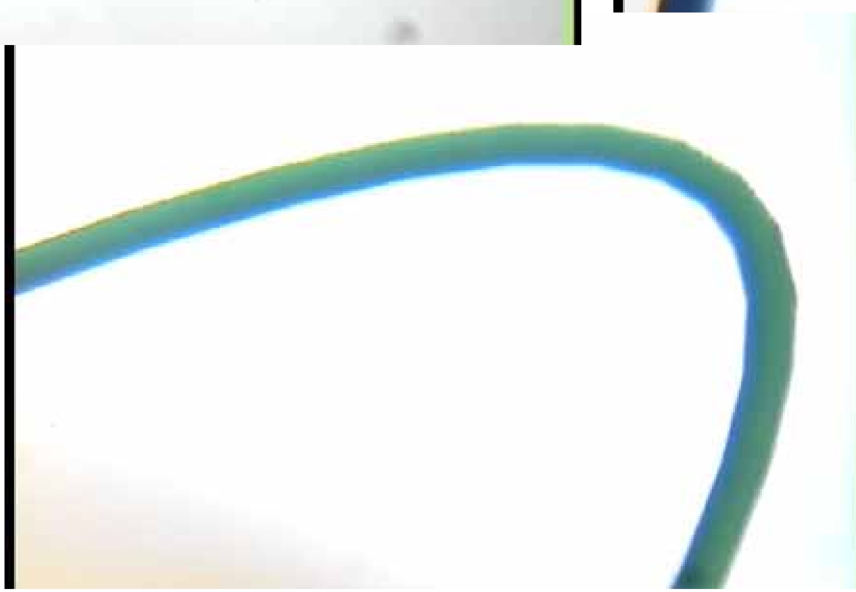
Mixing in a Microfluidic Crystallization Reactor







With proper flow rates, good diffusional mixing can be achieved downstream in the microchannel

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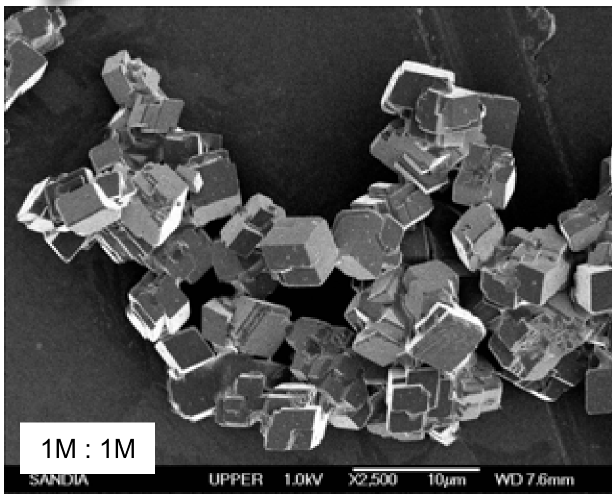
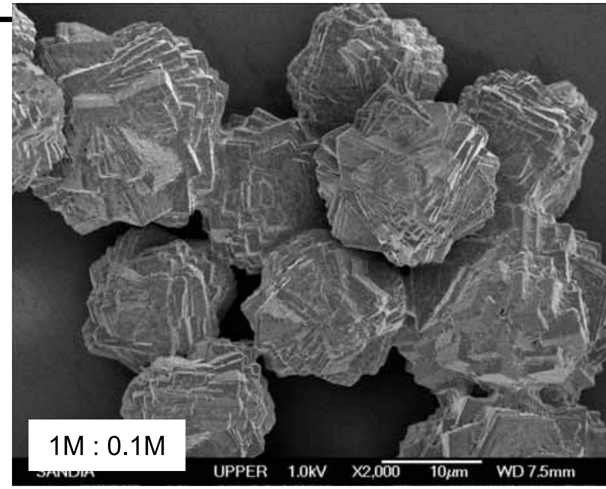
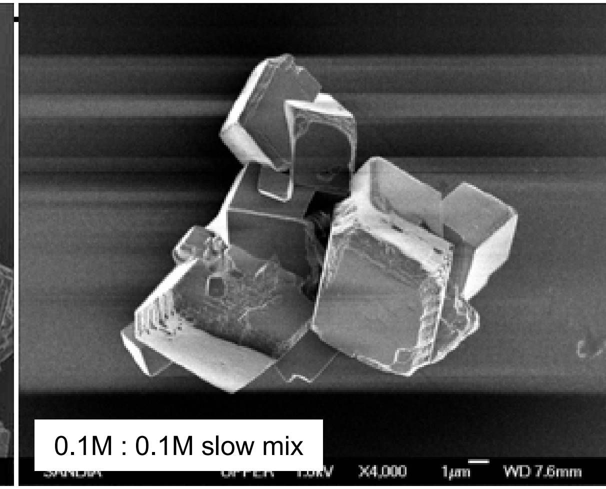
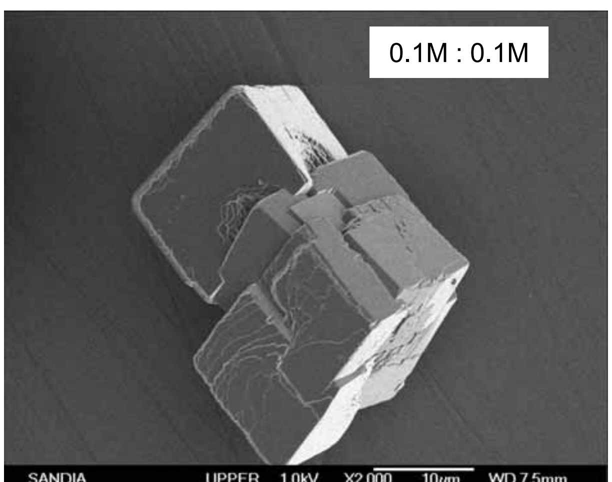
Crystallizations Using Surrogates Provide Insight Into Effects of Variations in Reaction Parameters

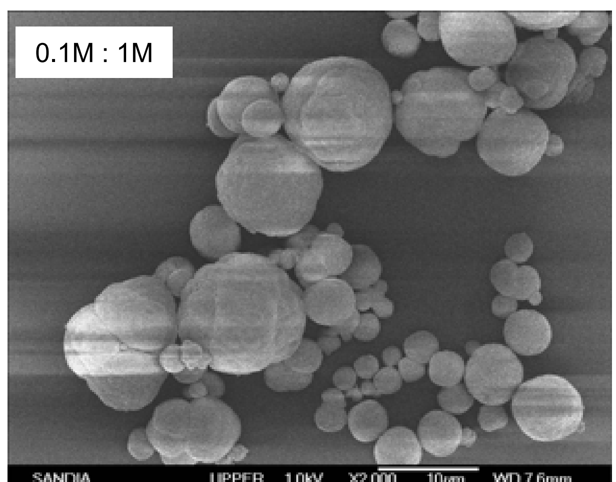


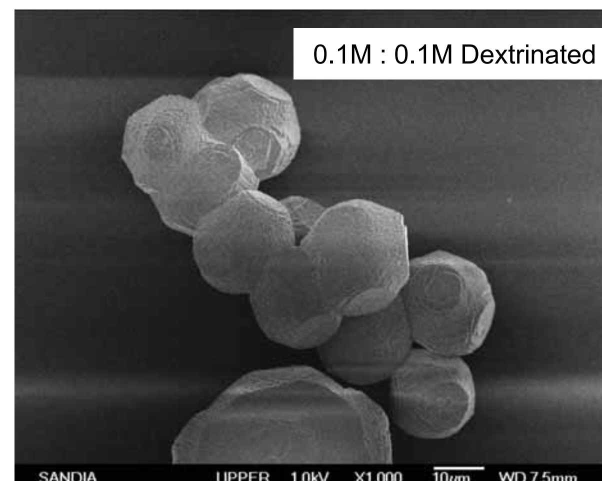




All these crystals are beaker batch-formed, intended to serve as baseline comparison to microfluidic synthesis







$CaCO_3$: Na_2CO_3 + $CaCl_2$ System

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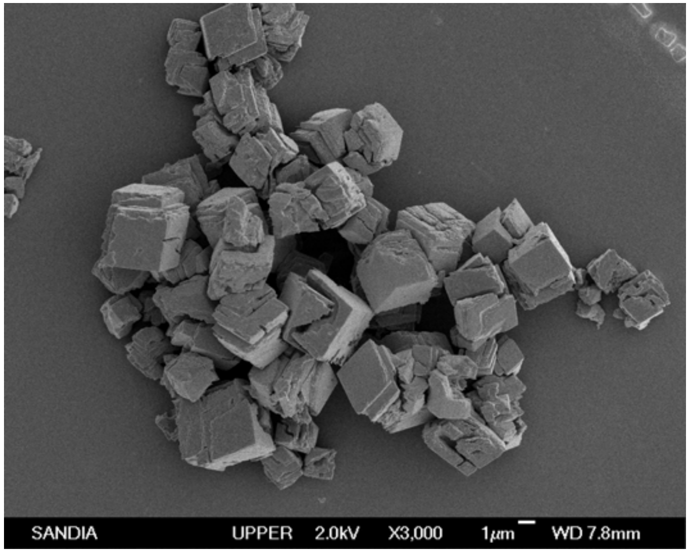
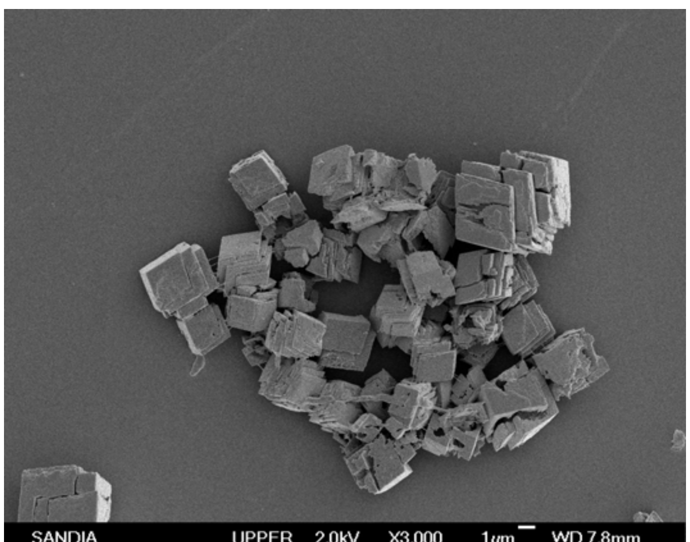
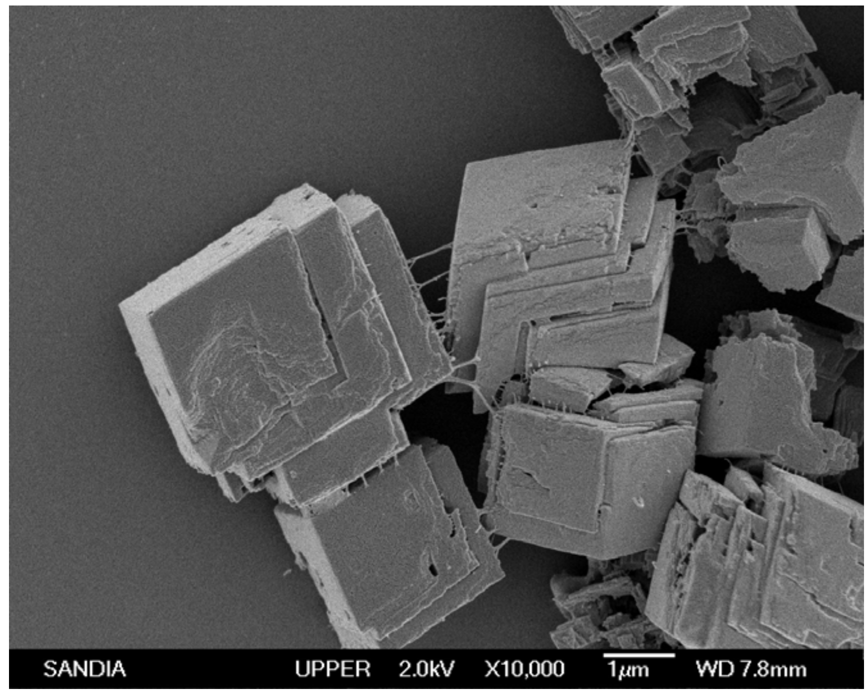
We've Begun to Synthesize Surrogate Crystals in our Microfluidic Crystallization Reactor





$CaCO_3$: Na_2CO_3 + $CaCl_2$ System



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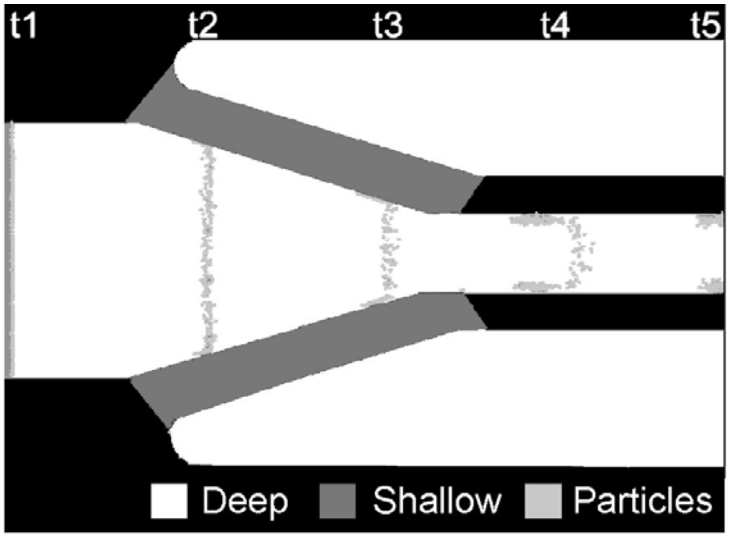
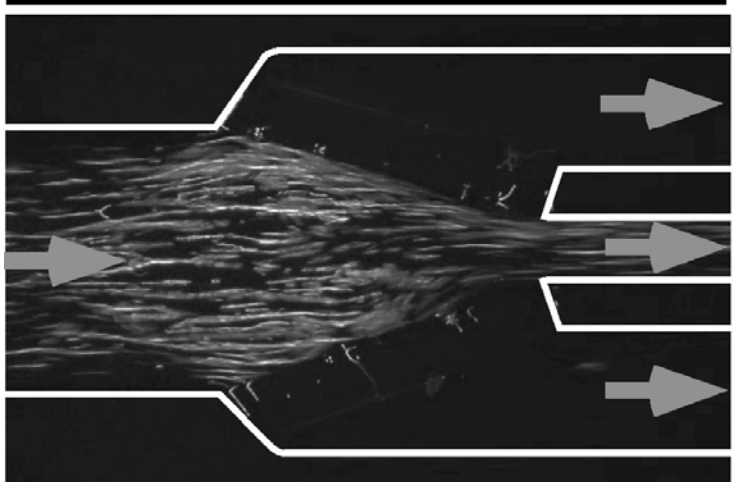
Sandia's Insulative Dielectrophoresis Should be a Key Microfluidic Means to Manipulate Particles



Analytical Modeling showing particle concentration resulting from iDEP "chevron" geometry

Sandia's iDEP (Insulative Dielectrophoresis) technology can be used to concentrate and separate particles in a microfluidic flow



Experimental concentration of fluorescent polystyrene particles by iDEP "chevron" geometry

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Microfluidic Synthesis of Lead Azide

- Summary of Progress Through FY06 Q2 -

- We’ve completed micromolds for molding plastic wafers containing various crystallization microreactors; We've used these micromolds to produce solvent-bonded wafer sandwiches (microchannels and cover) for experiments.
- For surrogate chemistry crystallization studies, we’ve assembled a microcapillary-based microreactor apparatus using custom components from related Sandia microChemLab projects. Underway are mixing tests and precipitation trials with 1st surrogate ($CaCO_3$) and inorganic lead compound surrogates ($PbSO_4$, $PbWO_4$)
- We’ve are pursuing methods of materials characterization available at SNL/CA for nanoparticle outflow of microreactors. Dawn Eos light scattering photometer; Raman microprobe; IR; all can be coupled to capillary outflow.

Acknowledgements

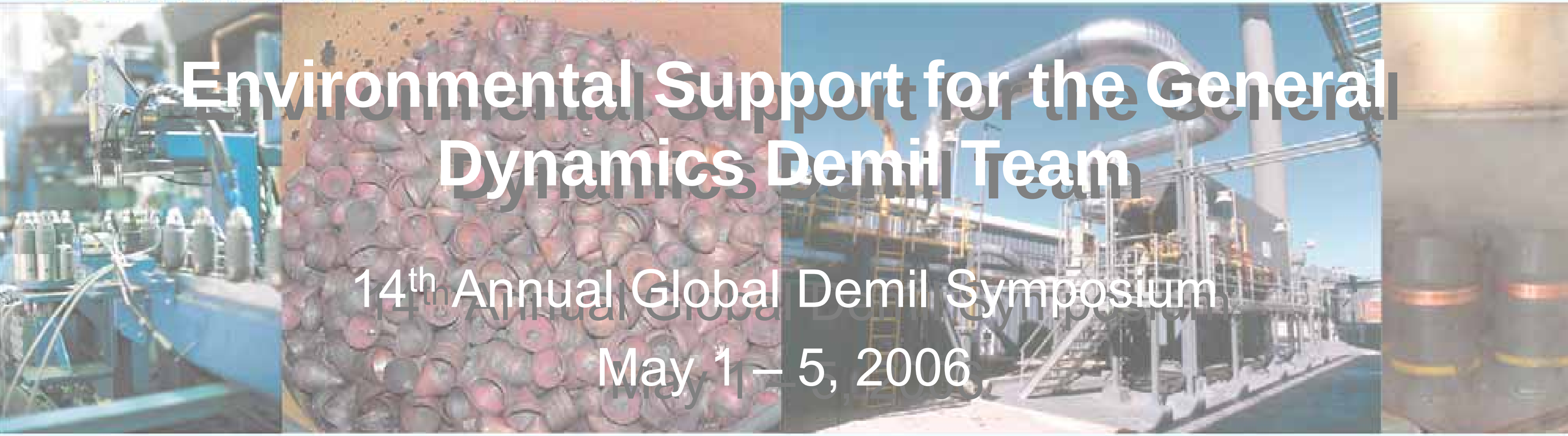
This Project is an FY06 new start project jointly funded by the DOD and DOE through a Memorandum of Understanding between the DOD with the DOE and Sandia National Laboratories.

The project team gratefully acknowledges Sandians Darren Hoke and Walt Wapman for their support for inclusion of this work in Sandia's project activities under the DOD/DOE Memorandum of Understanding. Acknowledgement is also due to former Sandians Brent Horn and Cindy Harnett for their involvement in the technical conception of this project, and to Cindy Harnett for the design of the initial microreactor wafers.

The project team also gratefully acknowledges Mr. James Wheeler and his colleagues at the Defense Ammunition Center for their interest in the potential of this work to improve the safety of storage and handling of lead azide for DOD ammunition applications.

Sandia National Laboratories

DEMILITARIZATION



Environmental Support for the General Dynamics Demil Team

14th Annual Global Demil Symposium

May 1 – 5, 2006

Carl S. Christiansen, EASE, Inc.
Demil EH&S Specialist
801-539-0100
carlc@ease-inc.com

GENERAL DYNAMICS
Ordnance and Tactical Systems

DEMIL
GENERAL DYNAMICS
Ordnance and Tactical Systems

Resource Recovery and Recycling (R^3)

- Propelling Charge Cans Used to Manufacture Rebar by Border Steel
- Border Steel Rebar Used to Build a Test Stand at Dugway Proving Ground (test new propelling charges and automated firing system)

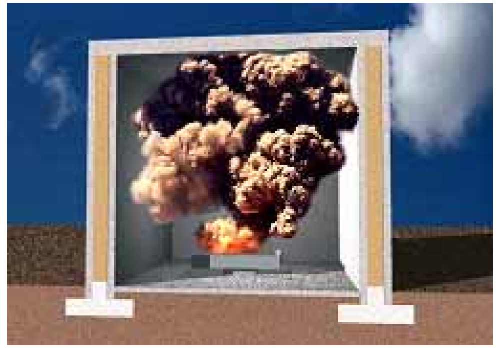
IDIQ Background

- Solicitation was released in 1998 for IDIQ contracts for the private sector to demil obsolete ammunitions
- One of the solicitation's primary requirements placed a very high priority on Environmental, Health, and Safety (EH&S) issues
- One of the two contracts was issued in May 1999 to General Dynamics
- EASE, Inc. contracted by General Dynamics to provide Environmental, Health, and Safety (EH&S) specialist support

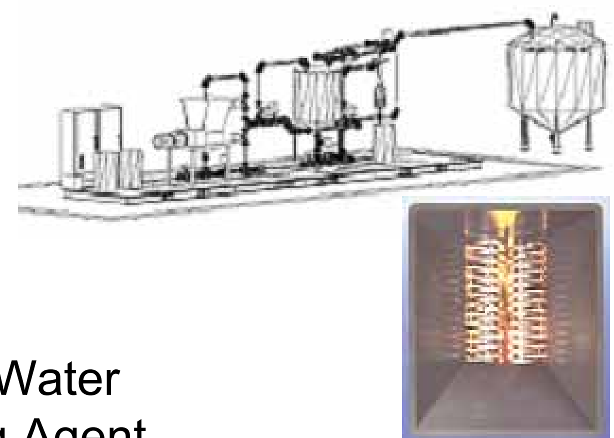
EASE, Inc. Demil Work

Bomb Washout

Confined Burn



Base Hydrolysis



Propellant Water
Gel Blasting Agent

The Beginning

- EASE, Inc. worked closely with GD prior to the first solicitation, during the proposal process, and on-going since the first award
- EH&S strategy development prior to award in 1999
- Emphasis of EH&S importance written into Teammate contracts
  - EH&S federal, state, and local regulations and standards
  - Army and DoD regulatory and contractual requirements
- Demil database developed to track incoming and outgoing materials
- Close coordination with the Army

General Dynamics EH&S Management

- EH&S Management was and continues to be integral to the total General Dynamics program
- General Dynamics / Army Mission Statement
  - The Joint Demil Team is dedicated to providing safe, secure, and environmentally friendly demilitarization operations
  - We are committed to the continuous improvement of our systems, processes, and people, and resolution of all issues within the Team

Shared Goals

- Avoid personal injuries and environmental incidents
- Safe and secure handling of all explosive and explosive-contaminated material including no releases of energetics
- Capitalize on lessons learned and maximize best practices sharing
- Maximize R^3 including alternative technologies

R^3

- The many definitions of R^3
  - Resource Recovery and Reuse
  - Reduce, Reuse, Recycle
  - Recycle, Recover, Reuse
  - Reclaim, Reuse, and Recycle
  - Resource recovery, Recycle, and Reuse
  - Resource recovery, Reutilization & Recycling
  - ……….

Waste Minimization

- R^3 of 96+% by the General Dynamics Team
- Waste Minimization = Less Costs + Less Delays + Less Permitting
- Propellant – Used to Improve Water Gel Blasting Agents Performance

- High Explosives from Bombs used in Commercial Explosives

Waste Minimization (continued)

- Propelling Charge Cans used to Manufacture Rebar

Environmental Assistance

- Environmental Assistance provided to the Teammates by EASE
  - Conducted compliance audits and provided assistance to address and close out associated action items
  - Provided input for response to regulators and associated Code of Federal Regulations (CFR) citations and action items
  - Provided regulatory required training requirements table and summaries
  - Determination of R^3 regulatory requirements
  - Documented and provided 90 day storage area training requirements
  - Investigated and provided regulatory requirements concerning stabilizer content/categories and shipping

Environmental Assistance (continued)

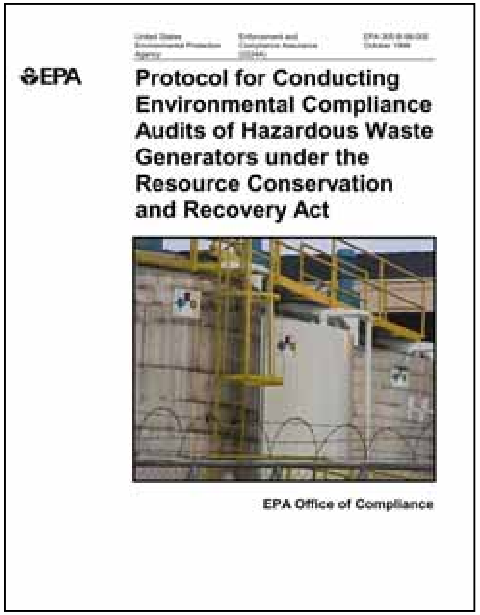
- Environmental Assistance Provided to the Teammates by EASE
  - Conducted air dispersion modeling to estimate air concentrations resulting from blasting agents use
  - Summarized EPA satellite accumulation area requirements
  - Reviewed and provided regulations concerning article exemption route and associated qualifiers for Lead Toxic Release Inventory (TRI)
  - Ran the EPA's TANKS 4.0 program to estimate emissions from tank sources
  - Notice of Intent (NOI) and other environmental permit support
  - Reviewed hazardous waste and air regulator compliance and permit files

Environmental Assistance (continued)

- Environmental Assistance Provided to the Teammates
  - Cat D Propellant and Hazardous Waste designation interpretations
  - Provided assistance for completion of Biennial Reports
  - Drafted and updated an Integrated Contingency Plan (ICP)
  - Provided Federal Register regulatory updates and state regulatory updates
  - Regulatory research on fugitive emissions and whether included in Potential Emission Rates
  - Reviewing SARA Title III Section 312 Tier II reporting requirements; created tables of chemicals by amount and location for emergency planning purposes
  - Plus provided over 40 other similar assistance tasks

Useful Tools

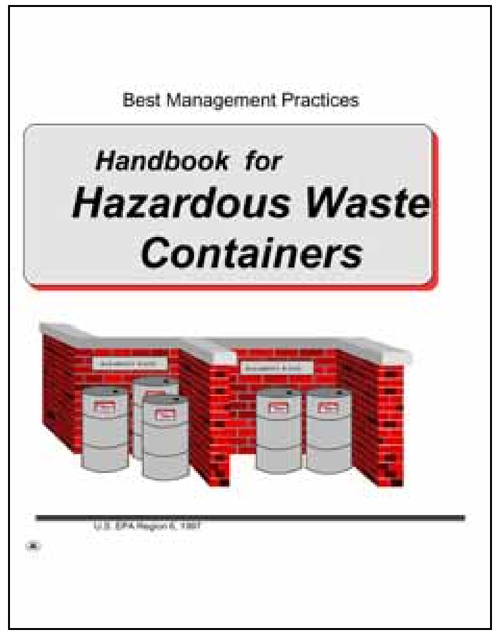
- EPA Protocol for Conducting Environmental Compliance Audits of Hazardous Waste Generators under RCRA
  - http://www.epa.gov/compliance/resources/policies/incentives/auditing/apcol-rcragen.pdf


EPA
Protocol for Conducting Environmental Compliance Audits of Hazardous Waste Generators under the Resource Conservation and Recovery Act

EPA Office of Compliance

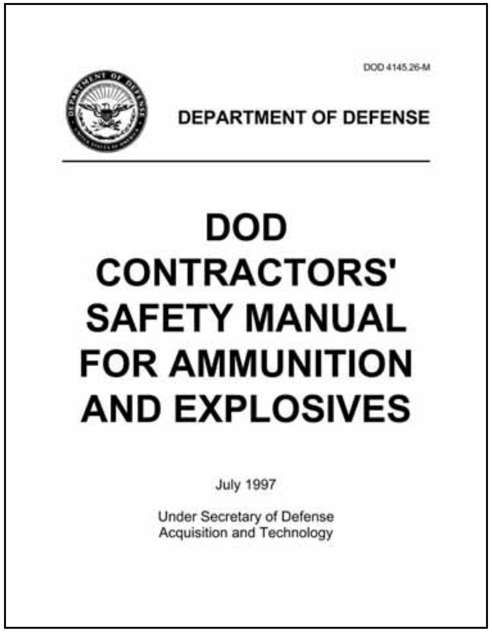
Useful Tools

- EPA Best Management Practices – Handbook for Hazardous Waste Containers
  - www.epa.gov/earth1r6/6en/h/handbk4.pdf



Useful Tools

- DoD 4145.26-M Contractors’ Safety Manual for Ammunition and Explosives
  - http://www.dtic.mil/whs/directives/corres/pdf/414526m_0997/p414526m.pdf


DOD 4145.26-M

DEPARTMENT OF DEFENSE

DOD CONTRACTORS' SAFETY MANUAL FOR AMMUNITION AND EXPLOSIVES

July 1997

Under Secretary of Defense
Acquisition and Technology

Continuing Support

No reportable incidents, no environmental releases, no lost materials

- Focus on Safe, Environmentally Friendly, and Effective Demil
- Continue to Provide EH&S Support
  - Compliance Reviews
  - Regulatory Interpretations and Alerts
  - Positive Assistance to Teammates, GD, and the Army

GD-OTS Demil Team

QUESTIONS?

Use of liquid (emulsion) explosives for bulk disposal of ammunition

Dr. Dov Herskowits
EMI (Explosives Manufacturing Industries Ltd)
Lt. Col. David Levy
IDF

May 2006

- The problem: disposal of ammunition
- The problem cont.: disposal of high-risk ammunition
- The solution: commercial emulsion explosives
- Emulsion: overview
- Emulsion: properties
- The technology: general description
- The technology: optimized method for each application
- Applications: a non comprehensive list
- Applications: economics
- Examples and Results
- Summary and Conclusion

IDF

THE PROBLEM

disposal of ammunition

IDF

in cooperation with the local industry

(IMI, EMI, Red Wings, etc.)

performs a large number of demil projects

Demil & Disposal Methods

- **Recycling**
  - air bombs
  - HE projectiles
- **Disassembling**
  - tank ammunition
  - rockets
  - small caliber
  - etc.
- **Conversion to training ammunition**
- **Burning in Chamber**
  - small arms <0.5”
- **Open Burning**
  - propelants
  - pyrotechnics
  - etc.
- **Open Detonation**
  - high explosives content
  - 20 mm, 40 mm, 155 mm Cargo, fuses
  - etc.

Some types of ammunition can’t be economically or technically disposed of but by OD

IDF

THE PROBLEM cont.

disposal of high-risk ammunition

- There is a special need for disposal of high-risk ammunition, which:
  - Poses high personal risk when disassembled,
  - Incurs high disposing costs
  - Involves use of sophisticated incinerators and disassembling systems or use of military explosives for OD
- IDF looked for a safe, cost effective method for disposing of such ammunition

THE SOLUTION

commercial emulsion explosives

- The solution - a well established, low cost, widely available family of commercial emulsion explosives.
- Safely transported, easily handled and poured using a commercial pumping system.
- Millions of tons are yearly manufactured and used in quarries and construction blasting for over 40 years.
- Various technologies serving the market.
- EMI is using the Austin Powder technology owned by Austin Powder corporation of Cleveland, OH.

IDF

EMULSION

overview

- The emulsion explosive is comprised of a non-explosive premix and a sensitizer.
- The premix consists of fuel oil and an aqueous solution of ammonium nitrate, and categorized as class 5.1.
- There are two methods of sensitization to get a class 1.5 explosive:

Micro-balloons, which are added during manufacture.

Gas micro-bubbles, generated by the addition of two sensitizing solutions to the premix at the blasting site.

EMULSION

properties

	Micro-balloons sensitized	Gas sensitized
VOD [m/s]	5900	5200
Density [g/cm^3]	1.2	< 1.2 reaction dependent
Shelf life	up to 6 months	hours
Flow [kg/min]	 up to 150	

Impact and friction – no detonation

Open fire – no detonation

THE TECHNOLOGY

general description

Placing the ammunition within an open container or pit.

Pouring of a predefined volume of emulsion explosive on top of the confined ammunition.

Initiation of the emulsion explosive.

Which initiates the ammunition.

Almost complete destruction of the ammunition.

THE TECHNOLOGY

optimized method for each application

- **Application related optimization:**
  - Confinement
  - Ratio between emulsion and ammunition volumes
  - Batch volume
  - Distribution of emulsion within confinement

APPLICATIONS

a non comprehensive list

- **Cluster projectiles**
- **HC based smoke projectiles**
- **Illumination projectiles**
- **Fuses**
- **Small caliber ammunition**
- **Ammunition with low explosive to metal ratio.**

APPLICATIONS

economics

Disposal of 38,000 cluster projectiles M449

32 days

6 workers/day

700 tons of emulsion explosives

0 duds

Disposal of 560,000 20 mm cartridges

4 days

10 workers/day

50 tons of emulsion explosives

0 duds

Description		
Quantity	4600	4600
Capacity per day	800	1600
Manpower	20	4
Disposal duration in days	6	3
Cleaning duration in days	1.5	0
Duds	~2 ‰	0 ‰

with Red Wings permission

IDF

EXAMPLES & RESULTS

Cluster Bombs M449
&
130 mm WP Projectiles
Captured in Lebanon

IDF

130 mm WP Projectiles Captured in Lebanon

Emulsion versus AT mines

Emulsion – NO DUDS

AT Mines –Fuming

And …One hour after….

IDF

155 mm Illumination Projectiles

&

155 mm HC Smoke Projectiles

20 mm Cartridges

SUMMARY and CONCLUSION

- This method enables bulk disposal of high risk types of ammunition
- reducing the risk involved in individual handling of each and every item.
- The bulk disposal, as opposed to the individual disposal, offers
  - a safe,
  - cost and labor effective solution to the disposal of ammunition in general and high risk ammunition in particular.

Thanks

Contact

dovh@explosives.co.il

Canister charges

Problem with old munitions in the stockpile

Joakim Hägvall

FOI

People behind this presentation

FOI- Swedish Defence Research Agency

- Joakim Hägvall

FMV- Swedish Defence Materiel Administration

- Anna-Helena Brandt

SRSA - Swedish Rescue Services Agency

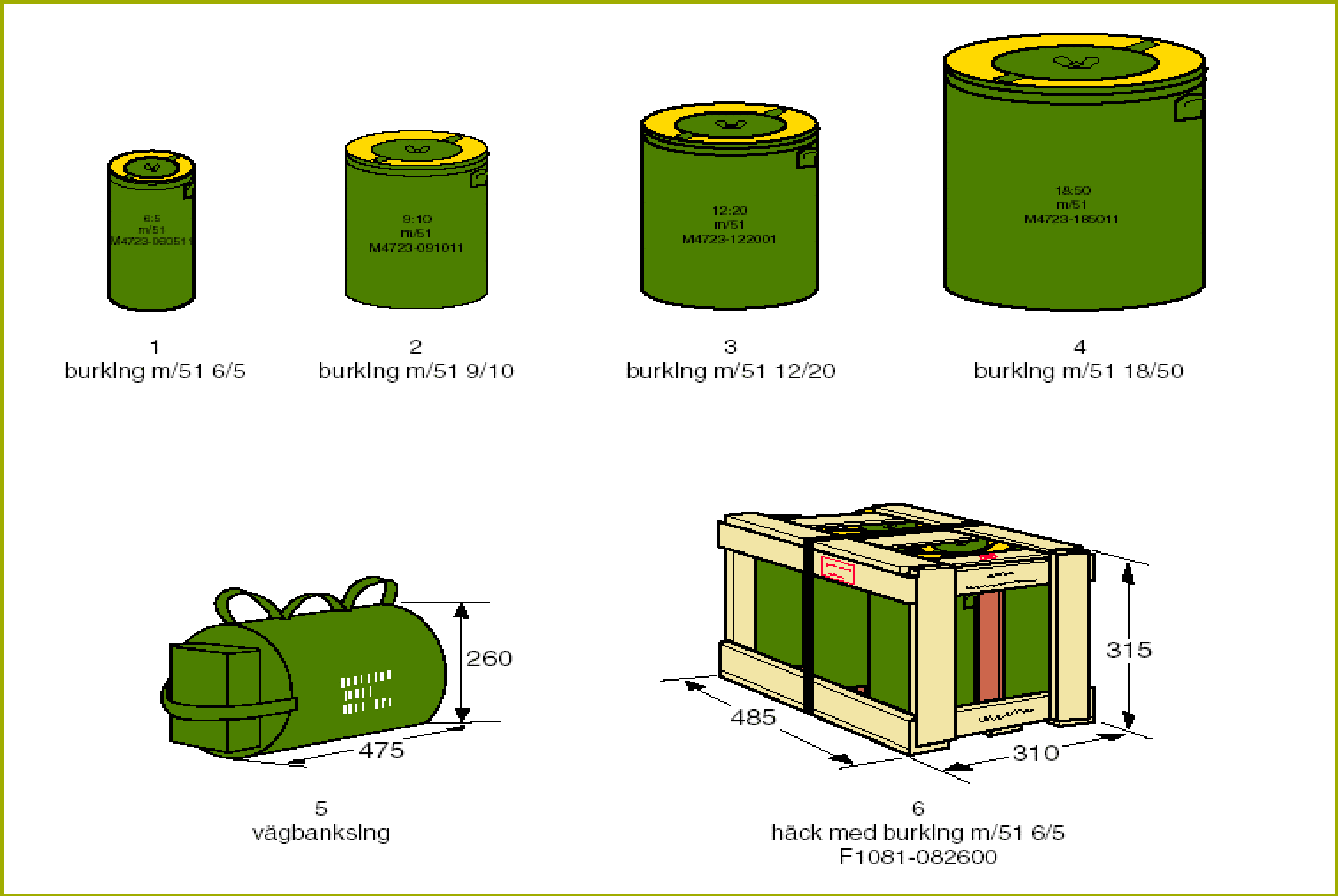
- Karin Alverbro

What is a Canister charge

- Premade
- Inexpensive
- Easy to use
- Large quantities

FOI

Canister charge



Specification of Canister charges

- Four sizes 6/5, 9/10, 12/20,18/50
- Based on a explosive called Nitrolite

Nitrolite

Ammonium Nitrate (NH_4NO_3)	76,4 %
Nitroglycol (NGL)	6,4 %
TNT products	11,7 %
Wooden flour	2,0 %
Silicon iron	1,0 %
Parrafin	0,5 %

The issue

Action taken place before 2000

- Problem noted ~1950-75 → No action
- Problem noted ~1982, the gas is analyzed, the concentration of hydrogen is below 4%
- Decision made to vent the swollen canisters → No action
- Demil decided of canister charges 2000. Problem noted → Assessment ordered

FOI

2001

- It was decided to demil the canister charges
- Demil company ask why some canisters has broken the wooden bracers that contains them
- A hazard assessment was made by FOI

Results of the assessment

- Risk analysis studied difference between swollen and non-swollen canisters
- Found no difference in sensitivity
- The analysis found that the swollen canisters were not more hazardous than non swollen

Decision

- Armed Forces wanted to demil the canisters
- Swedish Rescue Service put a handling stop for the canisters due to classification
- An expanded risk analysis was ordered from FOI

Expanded risk analysis

- What had happened with the nitrolite?
- How did this affect sensitivity and hazard?
- How would the canisters be handled?
- How to demil the canisters?

What had happened with the nitrolite?

- From literature: possible for ammonium nitrate to react with wood
- Test were made to see if this is possible
- Ageing test in 65°C
  - Ammonium nitrate, water and wood powder (dry)
  - Weight loss higher than amount water added
- Ammonium nitrate probably reacts with wood

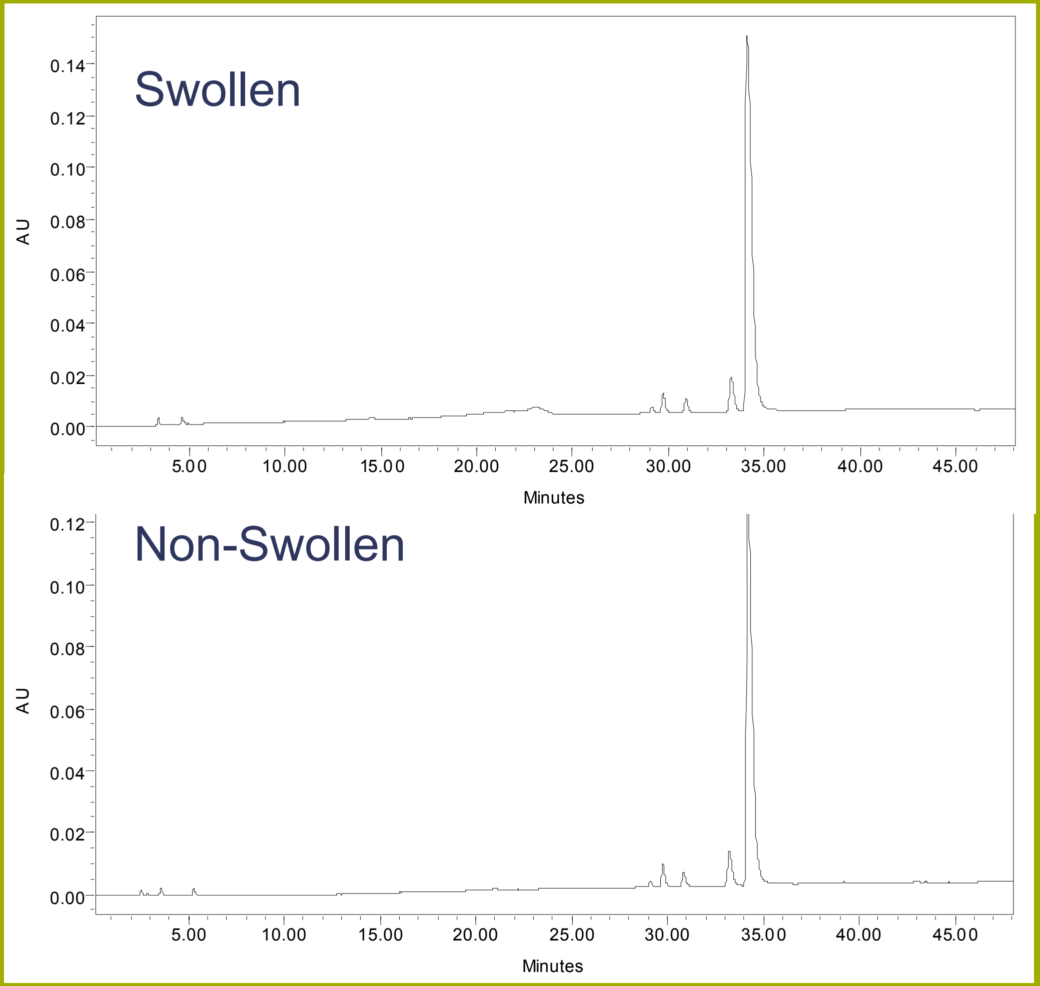
How did this affect sensitivity and hazard

- No “new” canister charges available
- Not possible to make “new” nitrolite
- Previous assessment compared swollen to non-swollen

FOI

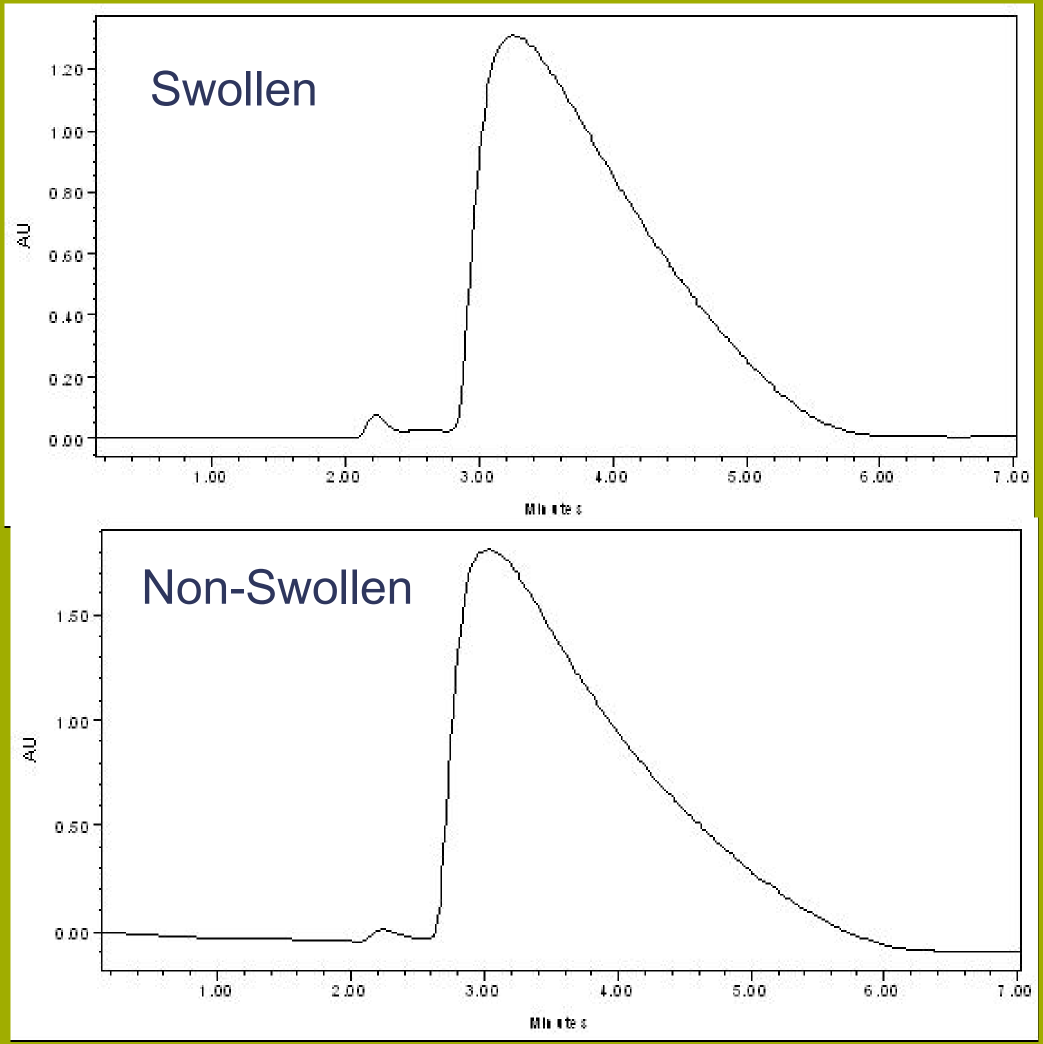
Swollen canister compared to non swollen

- HPLC
- EtOAc



Swollen canister compared to non swollen

- HPLC
- Water



Sensitivity

- Previous assessment didn't tell since swollen and non-swollen were the same
- Old data show that impact sensitivity should be around 20 J (BAM fallhammer, 2 kg)
- New impact test gives result of about 7 J
- A significant lower value

The result of the risk analysis

- The swelling of canister are probably because ammonium nitrate reacts with wood
- It is possible that the nitrolite is significant more sensitive to impact now than old values suggest

- 12 m drop test should be done with the canister charges

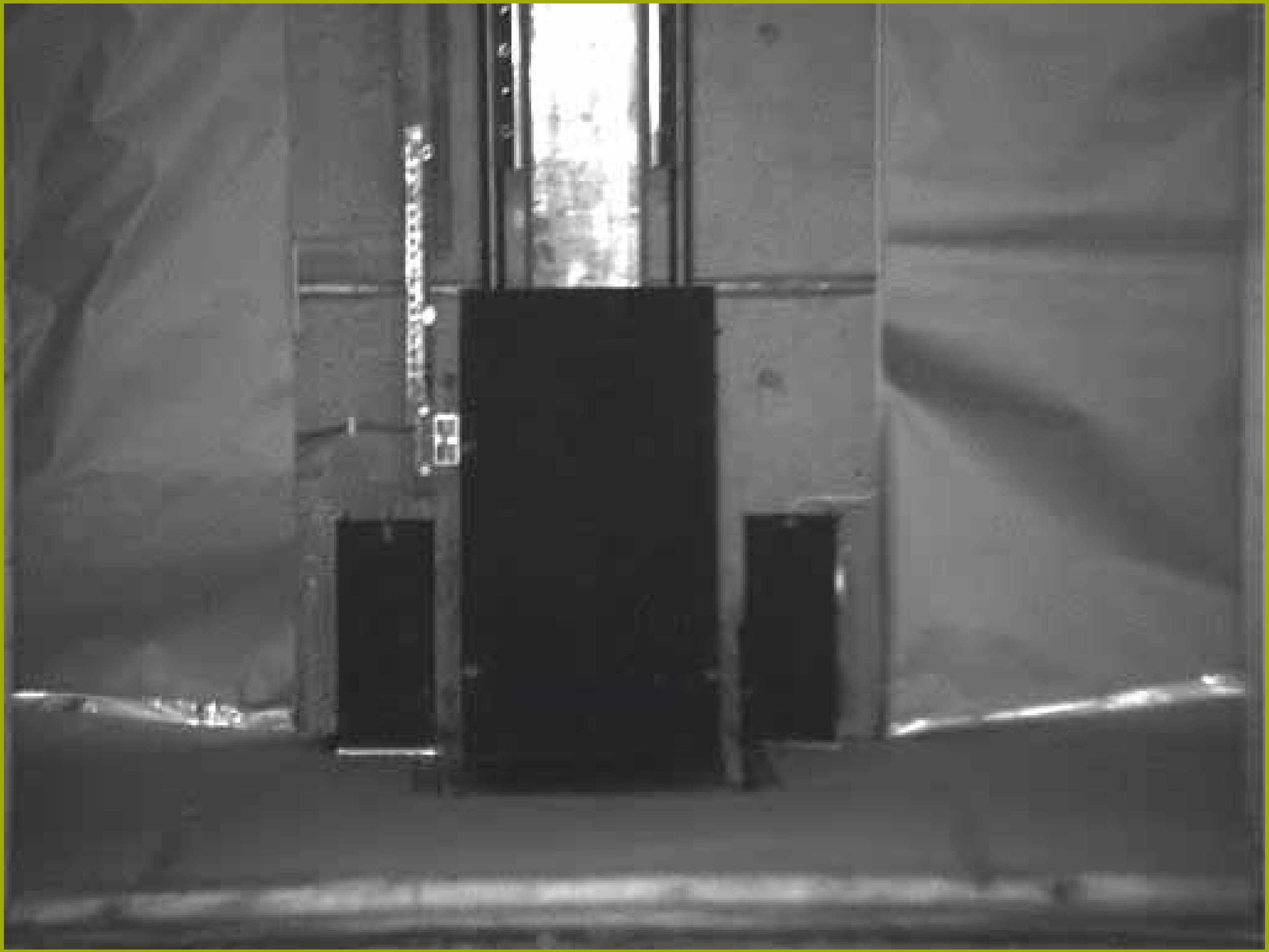
FOI

Testing

- Five 20 kg canisters were dropped from 12 m
- Swollen canisters were chosen
- The drop orientation differed




Testing II



FOI

Testing III

- No detonation or deflagration
- No penetration of canister

Decision 2

- Due to the result from the 12 m drop test the canisters were allowed to be transported
- Swedish Rescue Service decided that it was allowed to transport the canisters shorter distances within Sweden
- Immediate demil of the canisters were ordered and all storage facilities were emptied of canisters

Progress report

- Due to Swedish environmental regulation it was not possible to demil all at once
- Demil was performed under three year
- Summer of 2005, the last of the canisters were destroyed

The end

Discussion

- Known problem that were forgotten
- No one owned the problem
- People got used to the swollen canisters
- Assessment was made on incomplete information
- Decision maker didn’t se the problem

FOI

”Success is going from failure to failure with no loss of enthusiasm."

Winston Churchill

FOI

2006 Global Demilitarization Symposium & Exhibition

Indianapolis, IN

Wednesday 3 May 2006

AUTOMATED TACTICAL AMMUNITION CLASSIFICATION SYSTEM (ATACS)
APE 1996

Bruce G. Ramm
Non-Destructive Test Manager
SJMAC-DEE
DSN 956-8978
bruce.ramm@us.army.mil

Overview

- What is ATACS (APE 1996)?
- History
- Actions
- Current Status
- Technological Improvements
- DAC APE NDT Technologies

What is ATACS (APE 1996)

- **Automated Tactical Ammunition Classification System**

- **Automated Inspection/Sorting Machine for Unlinked Small Arms Ammunition (SAA).**
- **Function of Machine.**
- **Operating Environment.**
- **User Friendliness.**

History

Email from BG Radin to BG Rafferty, CG JMC, 29 Feb 04

Guys:

The scope of effort here has been ~ 10M rounds of A059 alone! There HAS to be a better way to do this, and if not, we need to invest in a better way. We will be doing this RSOI for some time and the potential for savings is great given the amount of ammo we will go through as one unit replaces another.

BG Bob Radin

CFLCC C-4

CG, AMC SWA

History (cont)

- DAC was requested to develop an automated inspection/sorting machine for installation in Camp Arifjan, Kuwait.

- Automated equipment to sort bulk: 5.56mm, 7.62mm, 9mm, 45 caliber and 50 caliber ammunition and inspect for:

History (cont)

- Chambering dimensions and concentricity.
- Bent bullet tips, dents and corrosion.
- Perforated cartridge cases.
- Dents in cartridge cases.
- Discolored and/or corroded cartridge cases.
- Sorting by color of bullet tip (tracer, ball, etc.).
- Sort out foreign SAA .

History (cont)

- Inspection rate to be at an average of 1 – 2 cartridges per second.
  - 120 cartridges per minute.
  - 7,200 cartridges per hour.
  - 86,400 cartridges per 12 hour shift.
- Small footprint (102”L x 78”W x 96”H).
- One button ease of operation.

ATACS (APE 1996) in Action

Actions

- The DAC Equipment Engineering Division identified an existing Small Business Innovative Research Contract (SBIR).
- Reprogrammed existing Ammunition Peculiar Equipment (APE) dollars.

Actions (cont)

- Initiated a collaborative research project between DAC and Cybernet Systems, Ann Arbor, MI.
- Eight months from problem identification to equipment fielding (only 90 days from design and manufacture to field the ATACS (APE 1996)).

Current Status

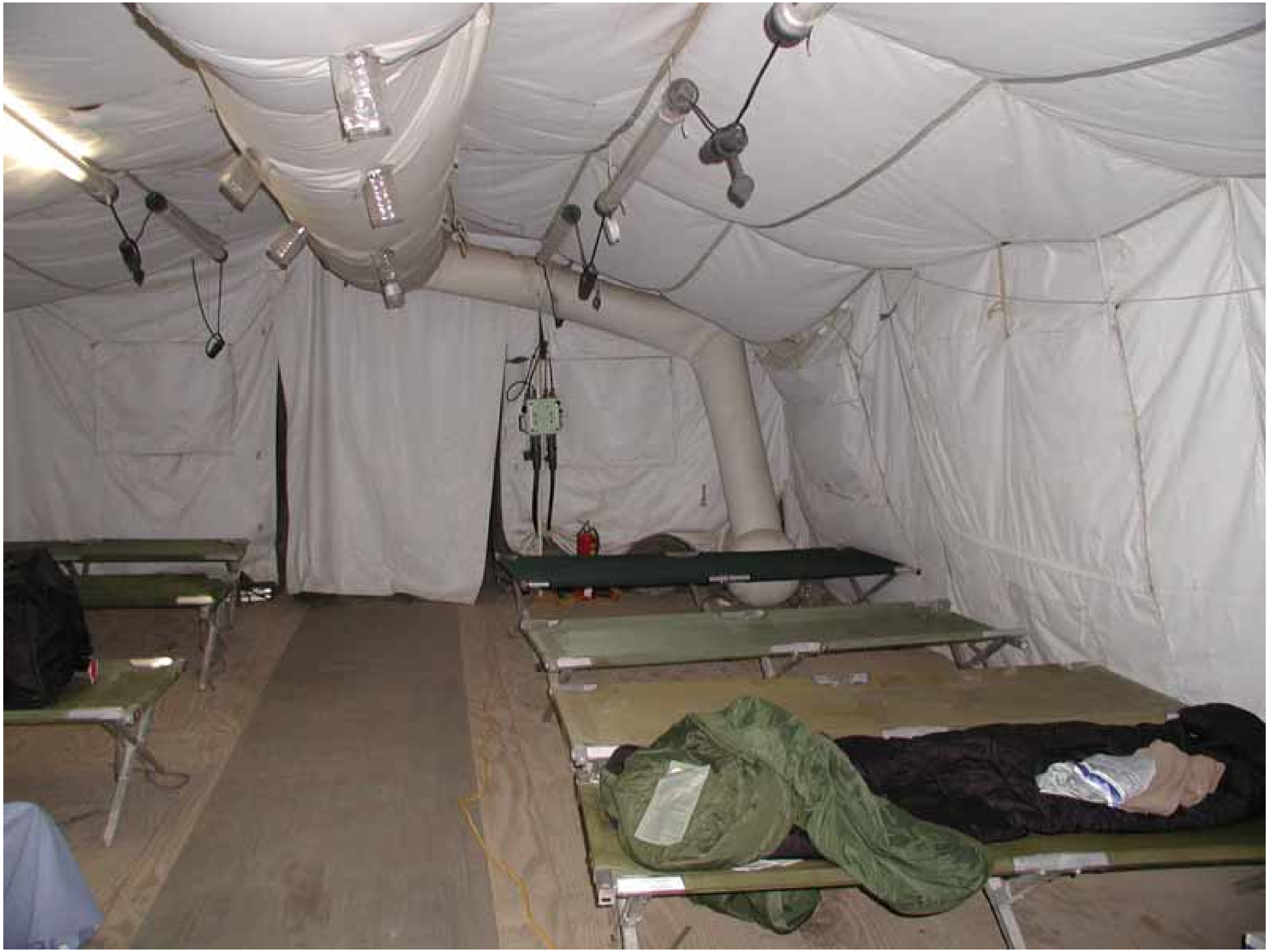
- ATACS #1 installed at Camp Arifjan, Kuwait - 25 Oct – 11 Nov 2004
- ATACS #1 in production at Camp Arifjan.
  - To date ATACS #1 has successfully inspected/sorted over 1.5 million rounds of SAA for reclassification for use in training.
  - Use of the ATACS has completed this process using only 1 – 2 personnel, whereas the previous process of manually performing this process took from 20 – 30 personnel.

Camp Arifjan Challenges

Camp Arifjan Challenges (cont)

Camp Arifjan Challenges (cont)

Camp Arifjan Challenges (cont)



Camp Arifjan Challenges (cont)

Camp Arifjan Challenges (cont)

Camp Arifjan Challenges (cont)

Camp Arifjan Challenges (cont)

Current Status (cont)

- ATACS #2 completed and undergoing validation testing at DAC (six sigma continuous improvement process).
- Add-on vibration/downdraft table being designed to pre-clean the SAA prior to automatically being fed into the hopper of the ATACS (APE 1996).

Current Status (cont)

- Once validation testing is completed the second ATACS will be ready for installation at any DOD site, as directed by HQ.
- Possible choices are Forts: Irwin, Polk, Hood, Bragg, Benning or Riley.

Technological/Portability Improvements

- Contract is underway to redesign the ATACS to be more robust and transportable.
- Addition of Optical Character Recognition to read head stamps and inspect primers.

Technological/Portability Improvements (cont)

- Next generation ATACS (APE 1996) designed to interface into a self-contained enclosure (Milvan, etc.).
- This self-contained Enclosure to be self-supporting. System will be supplied with all utilities (generator and air compressor) and all ancillary equipment.

Technological/Portability Improvements (cont)

- Assimilation of this technology to manufacturing plants.
- Determine feasibility of using the ATACS (APE 1996) for the sorting of spent brass.

ATACS Picture

DAC APE NDT Technologies

- Computerized Tomography/Digital Radiography Systems (APE 2257).
- Portable Small Item Automatic Real-Time X-Ray Examination System (PORTEX).
- Automated Conveyor & Robotics System (APE 2263).
- Real-Time X-Ray Systems (Image Intensifiers, Amorphous Silicon Flat Panels, Linear Detector Arrays, etc.) APE 2223.

DAC APE NDT Technologies (cont)

- Transportable Lead Rooms (APE 2264).
- 4 MeV Linear Accelerators (APE 2224).
- 320 KeV X-Ray Systems (APE 2248).
- Radiographic Inspection & Systems.
- Ultrasonic Inspection & Systems.
- Magnetic Particle Inspection & Systems.
- Liquid Penetrant Inspection & Systems.
- Machine Vision Systems.
- All NDT personnel NAS-410 Certified.

Progress on Recovery of Magnesium from Obsolete Pyrotechnic Flares

Stuart Nemiroff
Army Armaments Research, Development and Engineering Center
Picatinny Arsenal, NJ

Dan Burch
Naval Surface Warfare Center, Crane Division
Crane, IN

Ralph Hayes
El Dorado Engineering, Inc., Salt Lake City, UT

Kevin Hansen and Thane Morgan
TPL, Inc., Albuquerque, NM

2006 Global Demilitarization Symposium and Exposition
1-5 May 2005
Indianapolis, IN

Project Team

- Joint Service Partners:
  - U.S. Army RDECOM-ARDEC
  - U.S. Navy NSWC, Crane Division
  - U.S. Army Crane Army Ammunition Activity
- Industrial Partners:
  - TPL, Inc.
  - El Dorado Engineering, Inc.
- Program Sponsors:
  - U.S. Army Product Manager for Demilitarization
  - U.S. Army Defense Ammunition Center

Project Objectives

- **Design, build, and operate a prototype process for the recovery of magnesium (Mg) from obsolete or unserviceable illuminating rounds**

- **Requalify and use recovered Mg in new munitions**

Goals

- Reduce demil backlog of illuminating candles
  - Approximately 110,000
- Implement an R^3 effort
  - 350,000 pounds of Mg for reuse or sale
  - 240,000 pounds of sodium nitrate (NaNO3) by-product to sell instead of dispose

Benefits

- Lowers the cost of Mg to DoD customers
  - Estimated savings is up to $10 per pound of Mg
- Avoids incineration and potential environmental impact
- Eliminates single point failure in Mg supply
- Supports PM Demil's R^3 strategic goal

Project Backgound

- Under a Navy Phase 1 SBIR Project initiated in 1996, TPL developed a bench-scale process to recover Mg from illuminating flare compositions
  - Used anhydrous ammonia to extract NaNO3 and binder
- Process continued to evolve under Phase 2 SBIR, but problems persisted
  - Working with ammonia at required temperatures and pressures
  - Removal of flare composition from candle cases

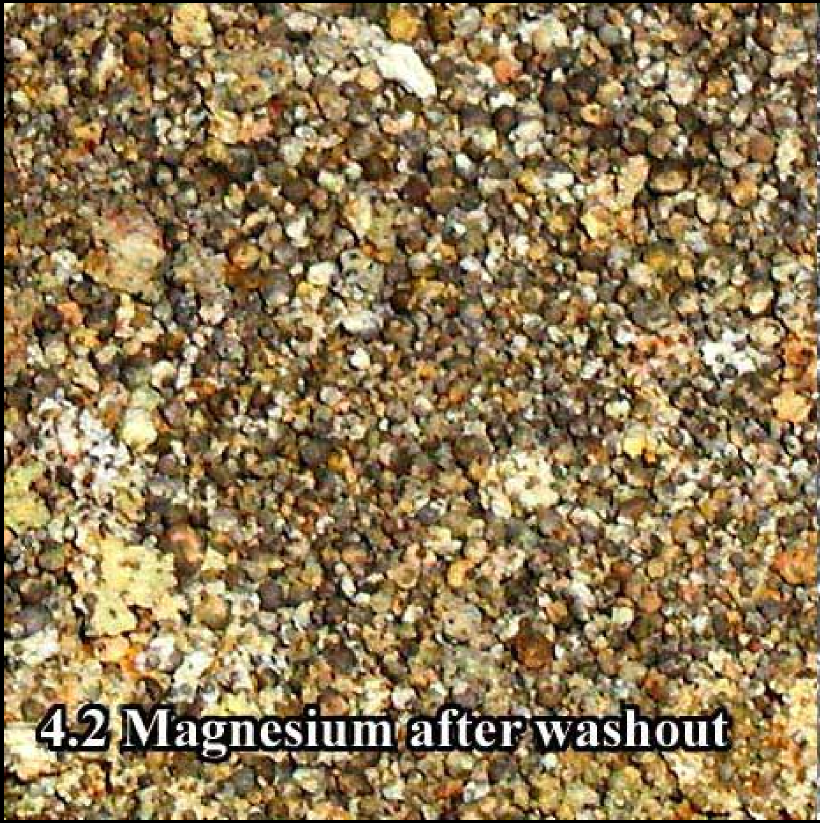
Project Backgound con't

- Multi-service interest in recovered Mg fostered Army/Navy partnership in 2000 on Phase III SBIR project funded under Army Demil R&D Program
  - Developed pilot-scale waterjet process to remove flare compositions from candle cases
  - Switched from ammonia extraction to water extraction; there was no Mg loss to oxide as long as temperature was kept low and contact time was short
  - All process steps demonstrated at the pilot-scale by TPL (Waterjet by NSWC)
  - Data used to develop a conceptual design for a prototype process
  - Recovered Mg successfully tested in M127 Hand Held Signal.

Results of Waterjet Washout Testing at NSWC-Crane

4.2-inch and 60-mm Illum Flares

Magnesium Recovered in TPL Pilot Plant



Current Program

- Under the continuing Phase III SBIR Project, a 3-stage effort has been undertaken
  - Stage 1: Detailed design of the prototype process
  - Stage 2: Procurement, fabrication and shipment of prototype process equipment to CAAA
  - Stage 3: Installation, start-up, demonstration and validation
- El Dorado Engineering selected as the engineering contactor
- Process will transition to support demil workload in FY 08.

General Requirements for Prototype Process

- One or two ten-hour shifts per day
- Recover 300 lbs of specification grade Mg for each shift
- Capability to process candles from 14 types of munitions

60-mm Mortars	155-mm Projectiles
81-mm Mortars	2.75” Rockets
4.2” Mortars	Mk 45 Aircraft Flares
105-mm Projectiles	LUU 2B/B Aircraft Flares

- Safely handle any hydrogen generation as well as all waste streams

Current Status

- Building at CAAA has been selected
- Detailed design is complete
- Procurement, fabrication and pre-shipment testing of long lead-time equipment item is nearly complete
- Plans are in place to complete procurement, fabrication and shipment to CAAA of all remaining equipment this year.

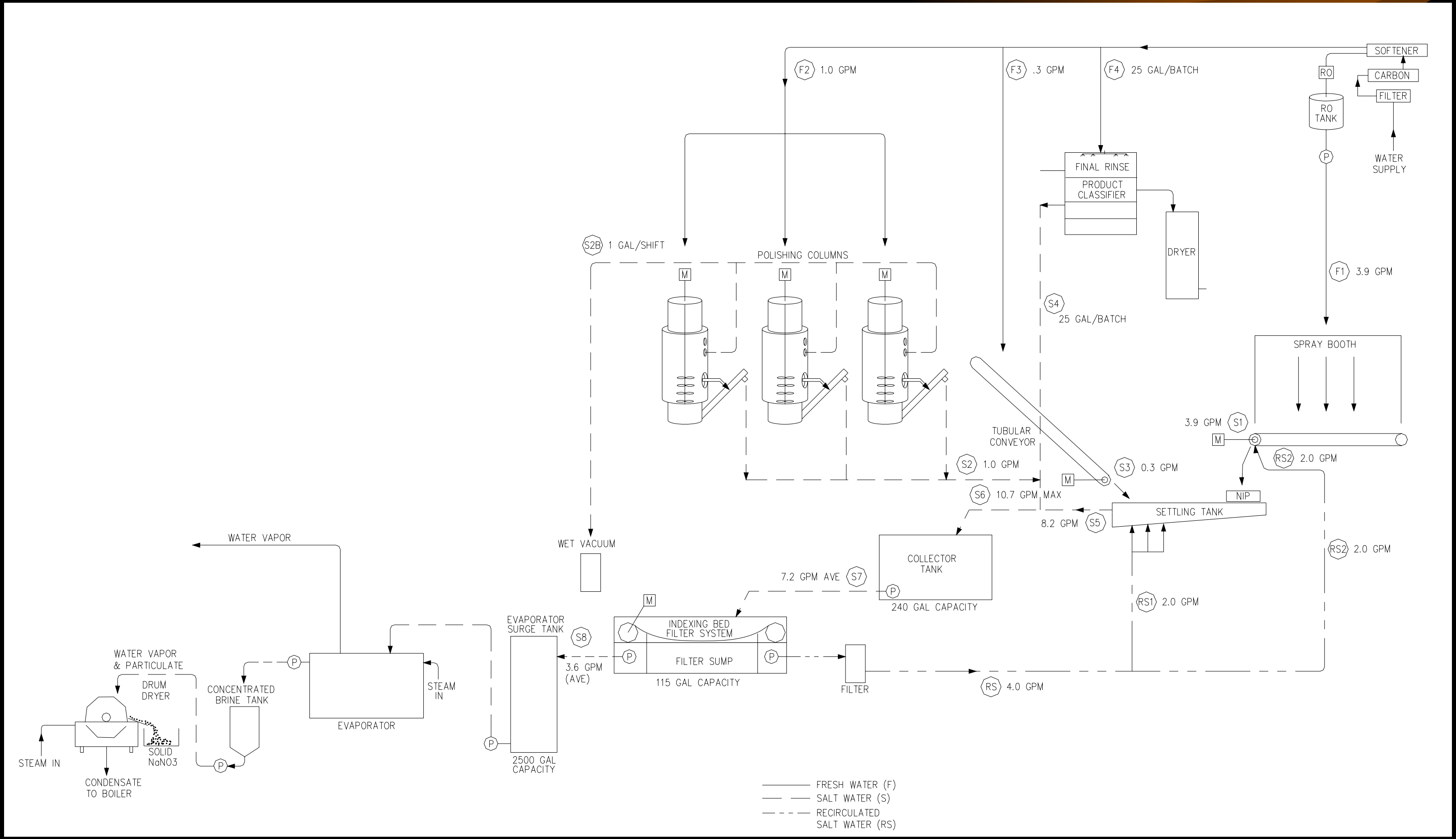
Magnesium Recovery Prototype Plant

- The MRPP consists of all the required equipment to:
  - Remove illuminant from a wide variety of military flares
  - Separate & recover magnesium in a directly usable form
  - Separate & recover sodium nitrate for reuse

Magnesium Recovery Prototype Plant

- The MRPP equipment is sized to produce 300 lbs of Mg / shift
- This requires a wide range of production rates
  - 60 mm M83A3 — 1,129 / shift
  - 4.2 M335A2 — 276 / shift
  - 105 mm M314A2 — 372 / shift
  - 155 mm M118A2 — 129 / shift
  - LUU2 — 26 / shift

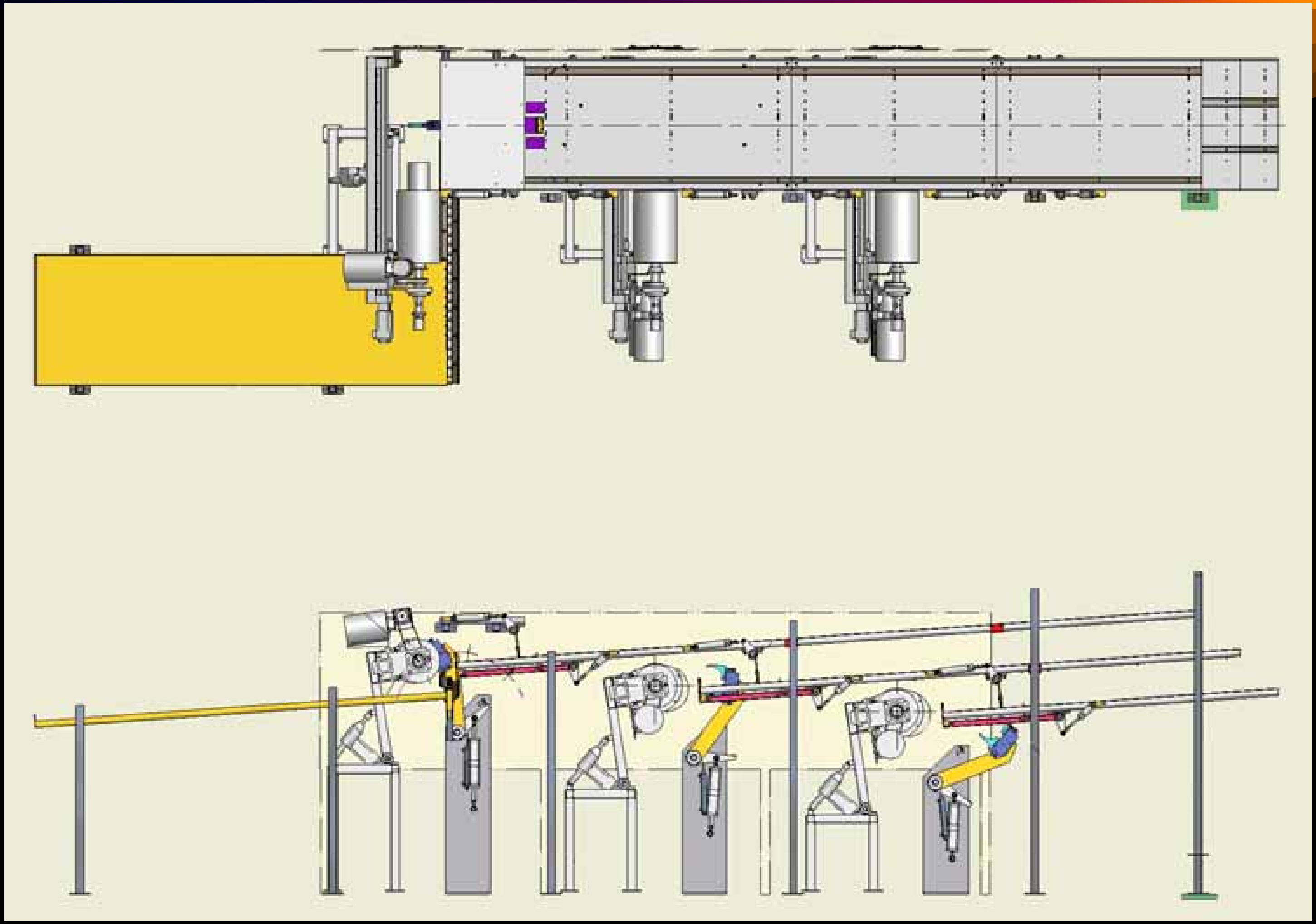
Magnesium Recovery Prototype Plant Equipment Layout



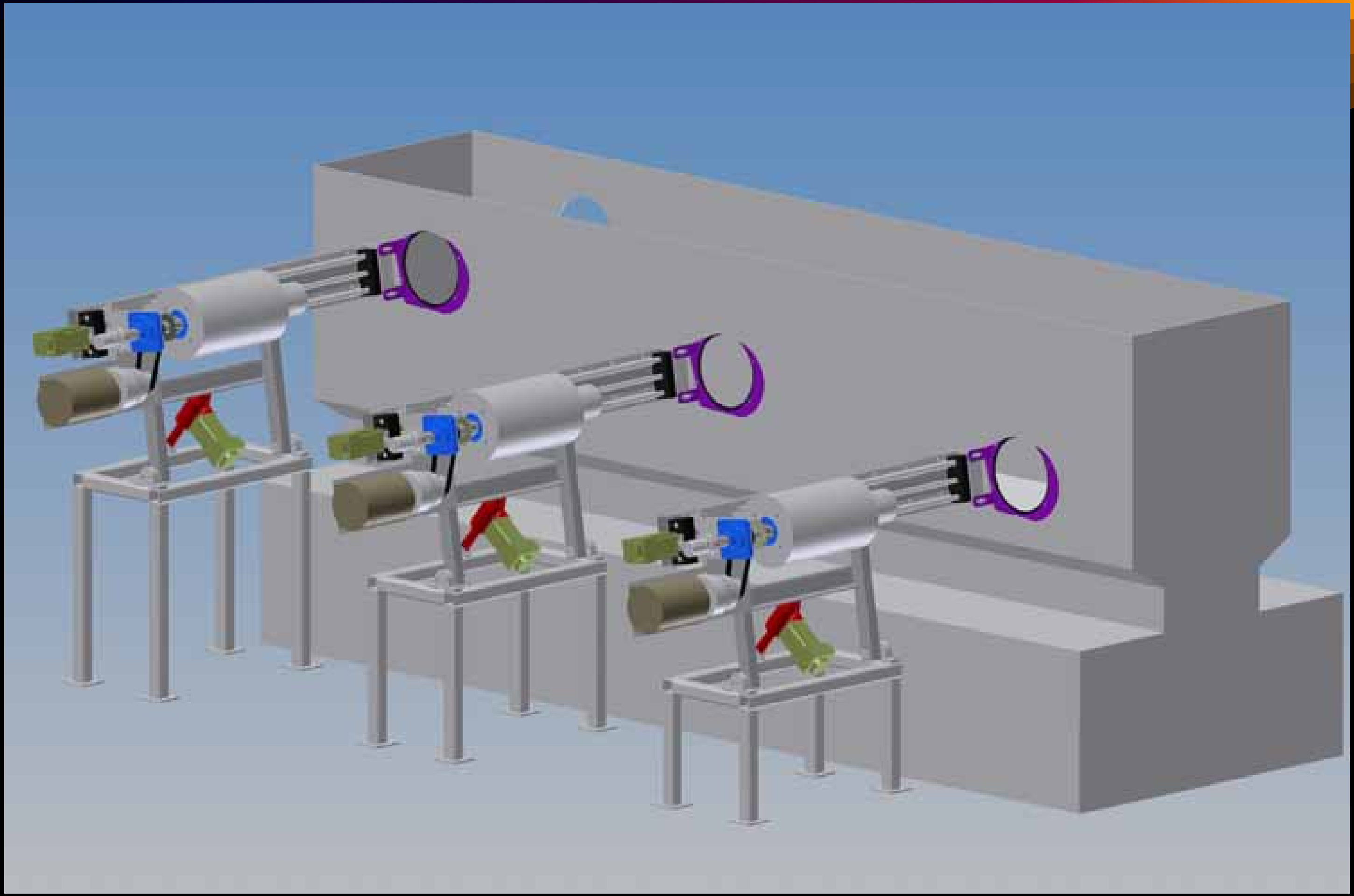
Current Work

- Prioritized Fabrication
- Candle Handling/Rotary Chuck
- Mg Drying
- Tubular Conveyor

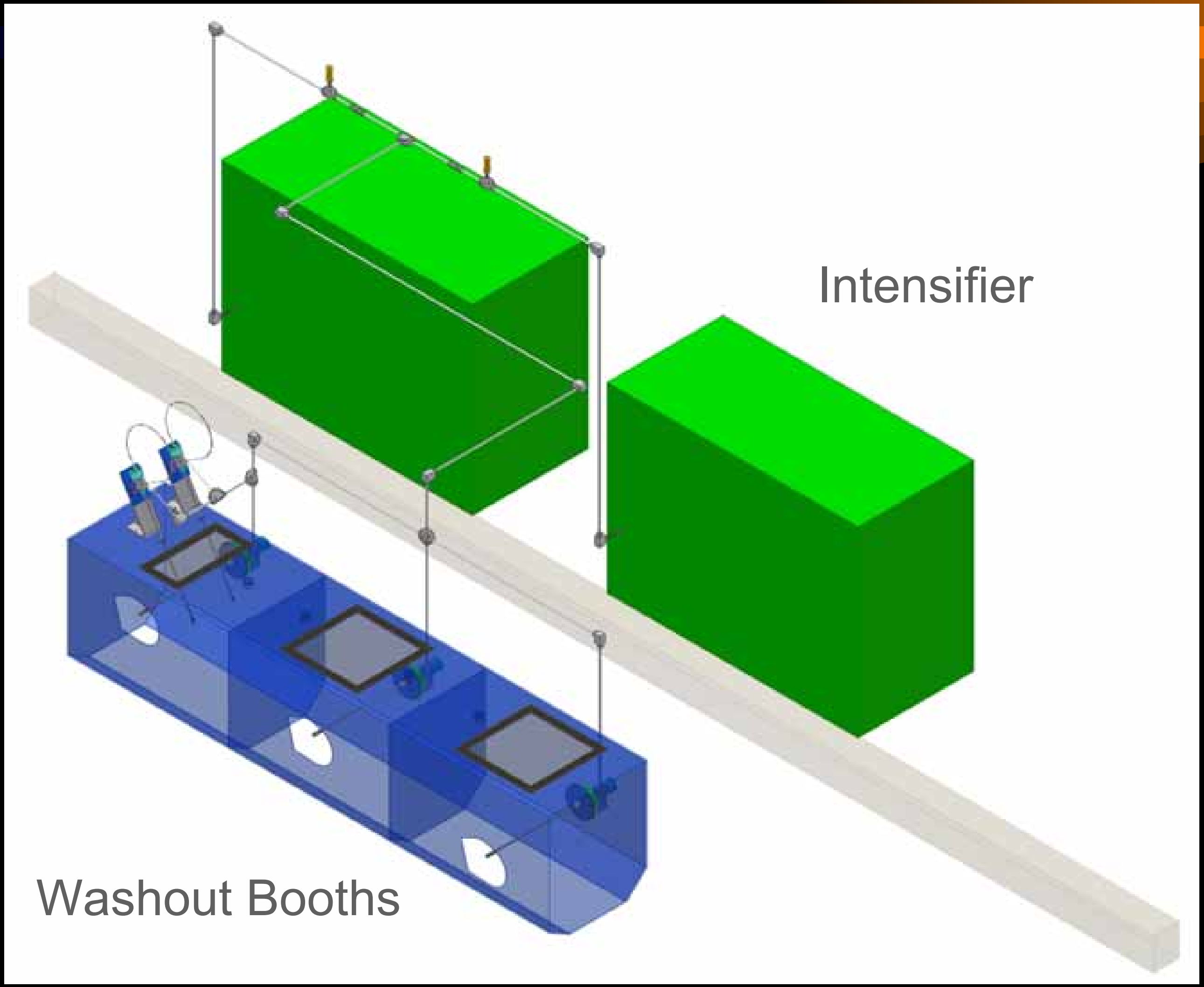
Magnesium Recovery Prototype Plant
Candle Handling System



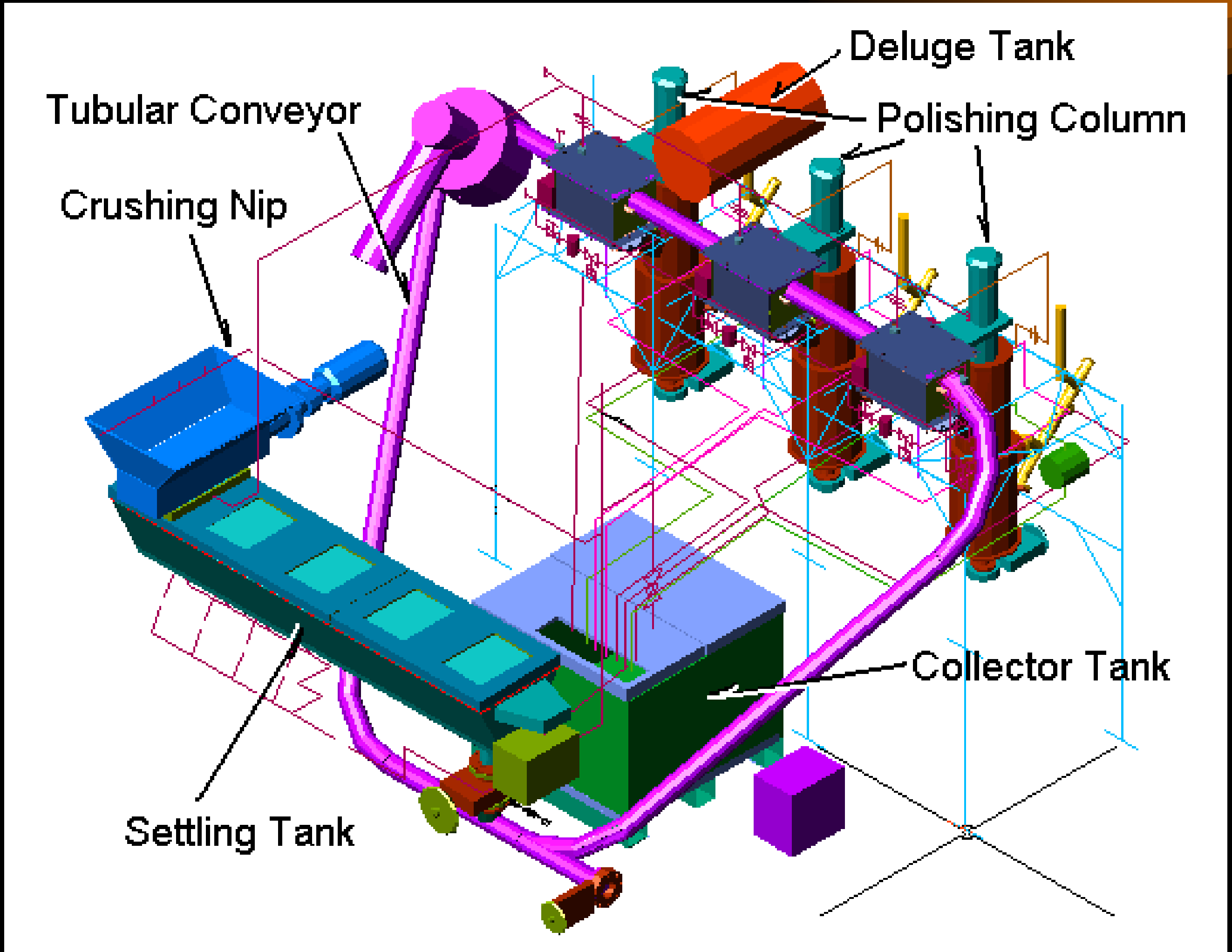
Magnesium Recovery Prototype Plant Rotary Chuck



Magnesium Recovery Prototype Plant Waterjet System



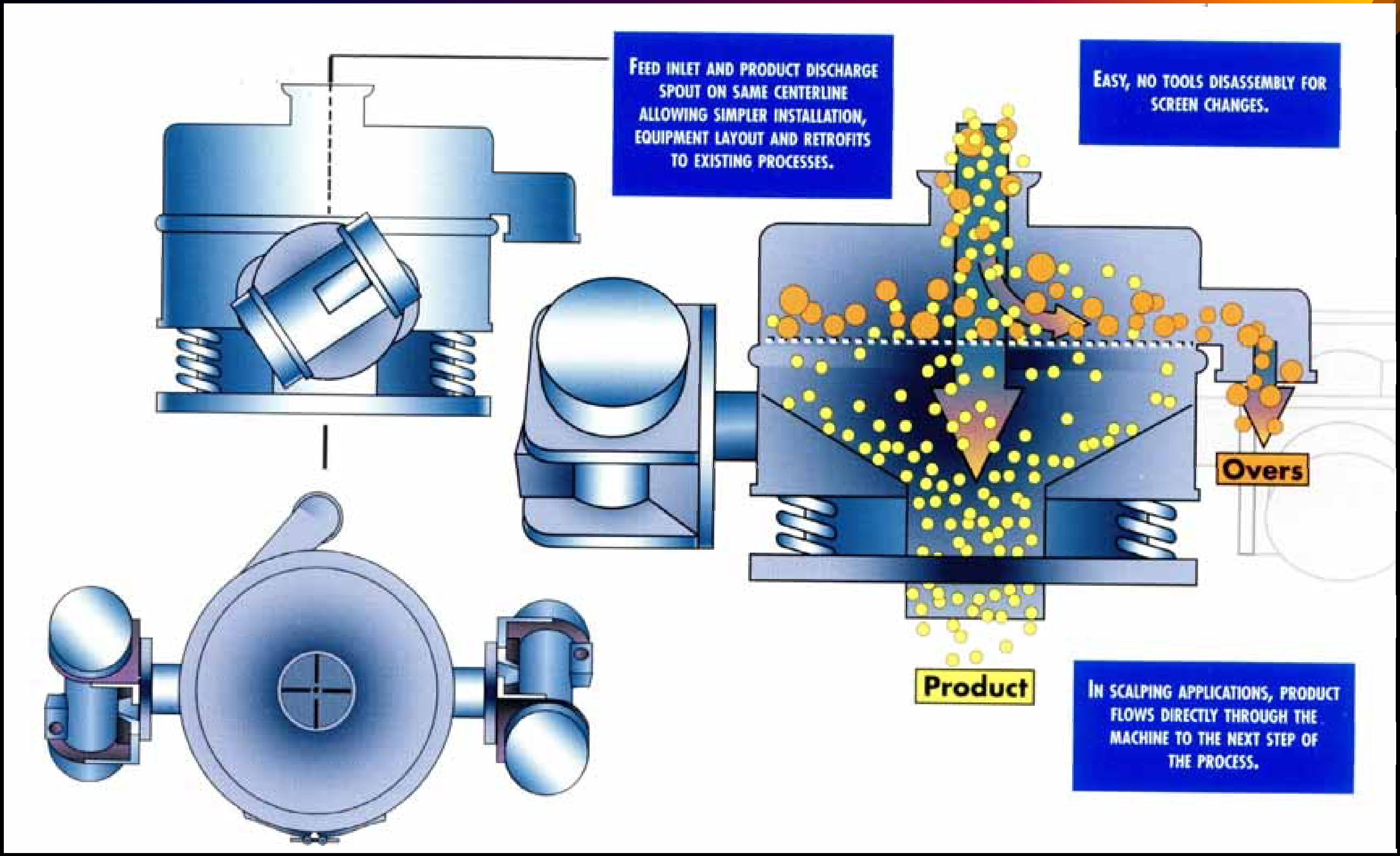
Magnesium Recovery System Plant Tubular Drag Conveyor



Tubular Drag Conveyor

- Moves ground magnesium from the settling to the polishing columns.
- Separate discharge gates to fill polishing columns separately.

Magnesium Drying Tests



Magnesium Drying Tests

- TEST SET-UP
  - 2 Horsepower Shop Vacuum
  - Duct Section (for velocity/flow measurement)
  - Air Capture Drum (Relative Humidity #2)
  - Hand Held Hygrometer
  - Excess Water Catch Basin (under the SWECO)
  - 40” SWECO Low Profile Separator (60 Mesh Screen)
  - Air Capture Drum (Relative Humidity #1)
  - Industrial Dehumidifier

Magnesium Drying Tests

Magnesium Drying Tests

Magnesium Recovery Prototype Plant

❖Project Status

- Fabrication of priority items underway
- Next step is to procure and fit up all equipment connected in the flare washout area

Summary

- Mg can be recovered via water extraction and purified by agitation in water
- Optimization of the pilot plant has reduced cost to recover Mg
- Customer support has been obtained in both Army and Navy for reuse in illumination rounds, signals, trip flares, and tracers
- Prototype facility start-up is planned for CAAA in FY 07/08
- Implementation of this technology avoids incineration, implements R^3 and provides the Services with cost-effective source of Mg that is no longer dependant on a sole source of supply.

Ultrasonic Fragmentation and Separation of Cast Energetic Materials

David Emery

U.S. Army Armament Research, Development and Engineering Center

Picatinny Arsenal, NJ

Catherine Malins and Randal Johnson

TPL Incorporated, Albuquerque, NM

2006 Global Demilitarization Symposium and Exposition

1-5 May 2006

Indianapolis, IN

Project Objectives

• Develop a process to ultrasonically fragment, and recover energetic material

• Design, build, and operate a pilot-scale process for the recovery of energetic materials from obsolete or unserviceable munitions

• Develop a conceptional design for large-scale prototype facility

Goals

- Develop and demonstrate technology for cast-loaded explosives (e.g. TNT, Composition B) in medium and large caliber ammunition

- Safely fragment and remove the explosive from projectiles using directed ultrasonic energy

- Apply directed ultrasonic energy to composite type explosives for a novel recovery method (new start SBIR)

Benefits

- Eliminates OB/OD and implements resource recovery and reuse (R^3), a strategic goal of PM Demil
- For cast loaded munitions provides advantages over autoclaving
  - Faster
  - No pink water generation
  - Cleaner metal parts
  - Anticipated lower costs
- Sonication is also applicable to high melting point and polymer-bonded materials for which other demil methods are not suitable (new SBIR)

Background

In 1995, ARDEC issued a Broad Agency Announcement requesting new ways of removing cast loaded explosives

- Fluorochem, Inc, Asuza, CA proposed use of ultrasonic energy for removal
- Contract awarded to Fluorochem under the Army Conventional Ammo Demil Program
- Conducted literature search, conducted inert ultrasonic removal tests and investigated sonication fluids

Background (continued)

Under an Army SBIR, initiated in 2002, TPL developed a bench-scale process to remove TNT and Comp B from mortar rounds (81-mm)

- **Use of ultrasonic energy and alcohol**
- **TNT recovered as granular material, Type III and Comp B recovered as granular material, Type II**

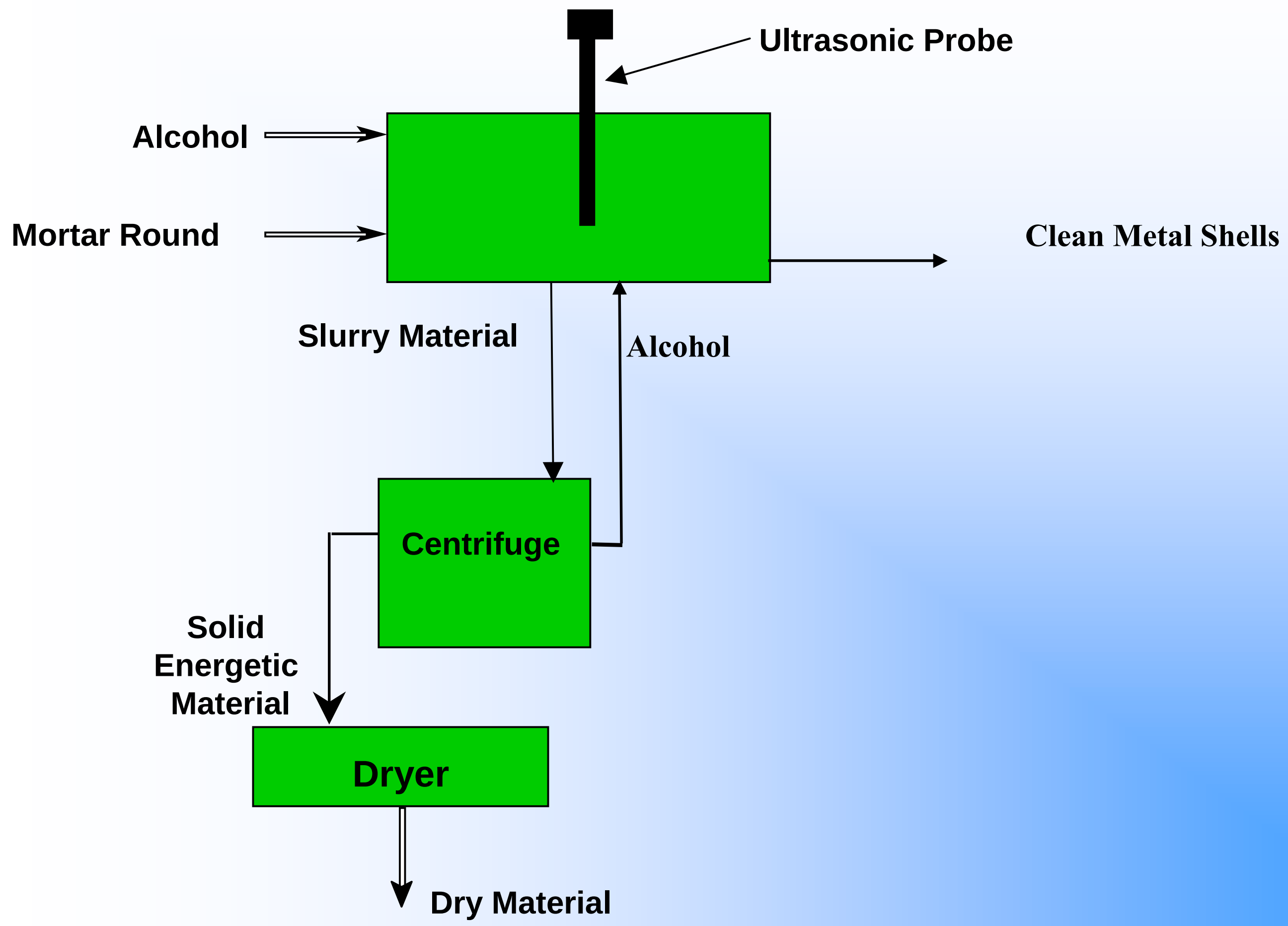
Sonication

An unexpected outcome of sonication of Comp B was the ability to separate the material into the constituents of TNT and RDX by selecting the appropriate solvent and filtering conditions

- **Separation has also been demonstrated for Octol, which can be separated into TNT and HMX**

- **Separation is being investigated under a new SBIR project**

Concept Block Diagram



Pilot Plant Facility
General Requirements

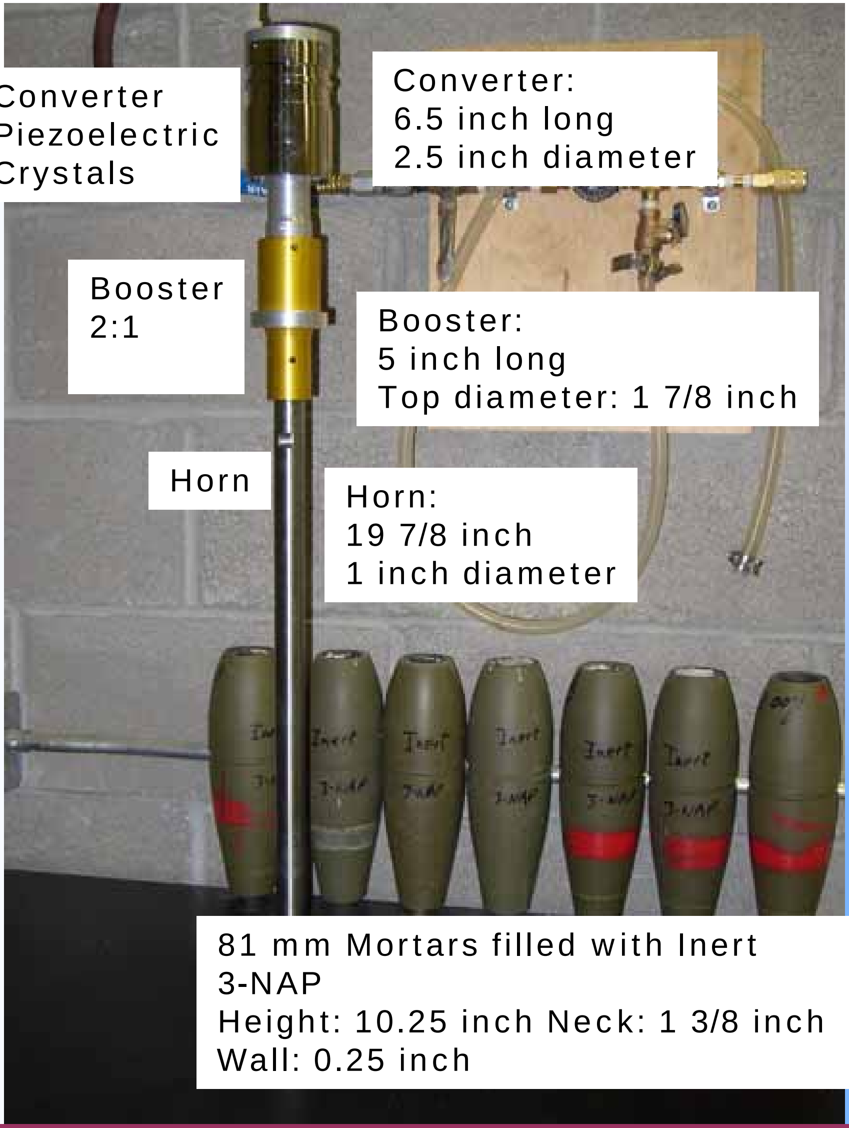
- Use the same sonication tank and basic equipment for TNT, Comp B, and polymer-bonded explosives

- Sonication tank is designed to switch between 81mm mortars, 60mm mortars, and 120mm projectiles. Future modifications will allow flexibility in handling other types of munitions

Sonication Equipment

Probe stack

Total length: 31 3/8 inch
Total weight: 6 pounds



Sonication Equipment

Sonication tank positioned above centrifuge.

Shells positioned in tank.

Sonication tank in movable frame

Lift plate holds 6 sonic probe converters.

Sonication Equipment

Sonication tank in bay 6A

Probes attached to lift plate

Vacuum cone dryer in bay 6B

Facility at Ft. Wingate Army Depot, Gallup, NM

Building 542

Control building

Control building interior

Ultrasonication Status

- Pilot plant equipment installation is essentially complete
- Software for remote control is being updated and video system is being installed
- Operations scheduled to begin May 15 2006

Key Pilot Process Features

- Manual loading of sonication tank
- High power sonication using 6 sonic probes
- Custom designed sonic horn design
- Alcohol as sonication fluid
- Sonication in batch mode
- After fragmentation and removal from shell, use centrifugation or other methods to separate energetic material from alcohol
- Recycle the alcohol to reduce waste stream
- Dry and package the recovered energetic material

Ultrasonication
Current work

- Complete the installation and use inert material to demonstrate the pilot plant sonication tank
- Operate using live material: TNT, Comp B and other PBX type materials
- Determine operating parameters

Sonication

Under a new SBIR contract awarded in Dec 2005

TPL has researched and demonstrated the separation of polymer bonded explosives for:

- **PBXN-106 (RDX /BDNPA/F / Polyethylene glycol)**
- **PBXN-101 (HMX / Laminac / Styrene)**
- **PBXN-8 (RDX / Steric Acid / Cellulose)**
- **PBXN-9 (HMX / Polyacrylic elastomer / DOA)**
- **PBXN-4 (DATB / Nylon)**
- **Comp A3 (RDX / Wax)**
- **LX-14 (HMX / Estane)**
- **Magnesium flares 4.2 (Granular Magnesium / Epoxy / Polysulfide)**

Future Work

- Demonstrations / validation of pilot plant
- Collect data on operating parameters
- Complete conceptual design for large-scale prototype plant
- Continue new SBIR effort on separation

Summary

- Rate of material removal for autoclave method for 81-mm mortar round:
  - TNT: 31 minutes
  - Comp B: 51 minutes

- Rate of material removal for sonication method for 81-mm mortar round:
  - TNT: 20 minutes(35% improvement)
  - Comp B: 23 minutes(55% improvement)

Summary

- TNT and Comp B can be safely removed by fragmentation using ultrasonic methods
- Material will be available for military or commercial reuse
- Sonication can separate Comp B, Octol, PBX and magnesium flares into their original component materials
- PBXN type explosives containing HMX, RDX, TATB, and metal containing materials can be safely sonicated, and separated into component materials
- Implementation of this technology avoids incineration and implements R^3

Recovery and Reuse of Core Ingredients from Decommissioned/Obsolete Gun Propellant

N. Orbey, Chunyong Wu, Lev Bormberg, E. Hicks

Foster-Miller, Inc.

Ed Jahngen, Umass Lowell

2006 Global Demilitarization Symposium

May 2006

Acknowledgments

- This research is supported by the United States Army RDECOM-ARDEC, Picatinny Arsenal through Small Business Innovation Research (SBIR) funding
  - Phase I Contract No. DAAE30-03-C-1030
    - Completed 12/2003
  - Phase II Contract No. W15QKN-04-C-1012
    - In progress

Foster-Miller
A QinetiQ Company

Presentation Overview

- Description of the problem
- Brief overview of R^3 demilitarization
- Foster-Miller's demil process
- Process kinetics
- Pilot-plant demonstration

Description of the Problem

- DOD stockpiles of obsolete, excess, and off-spec munitions
  - Millions of pounds of multi-base gun propellant exist, some as bulk material, some in yet-to-be demilled rounds
  - Stockpiles are growing despite efforts to reduce
  - Basic cost of OB/OD disposal ~$900/ton
- Currently no domestic source of nitroguanidine (NQ)
- R^3-type recovery process desired for gun propellant formulations

Resource Recovery and Reuse (R^3)

- Requirements for explosive wastes processing
  - Safety
  - Recover valuable energetic materials for reuse and/or produce high value by-products
  - No discharge of toxic-materials to the environment
  - Cost-effective
  - Capable of high throughput for bulk processing

Foster-Miller Solution

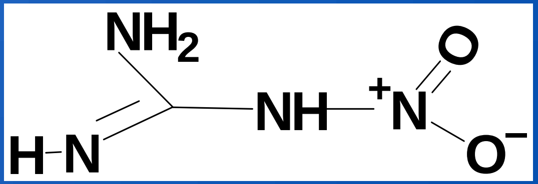
- Develop a cost-effective and safe process for NQ, NC, and NG recovery from waste gun propellants and assess the viability of a commercial-scale operation

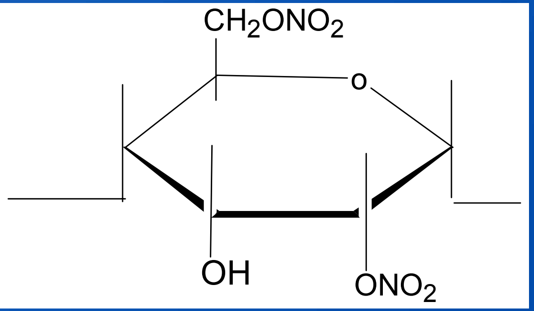
Foster-Miller Solution
R^3 Products

- Nitroguanidine (NQ) suitable for reuse by the military
- Nitrocellulose (NC) in a form useful for industrial and biomedical applications
- Nitroglycerin (NG) suitable as a feedstock for the pharmaceutical and blasting industries

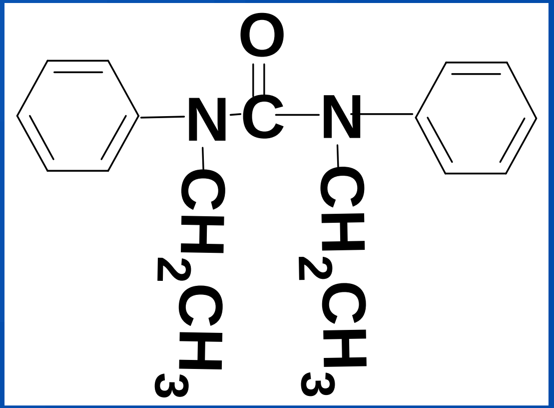
Gun Propellant Compositions

Component	M30A1*	M31
Nitroguanidine, NQ	47	54
Nitrocellulose, NC	27	20
Nitroglycerine, NG	22.5	19
Ethyl centralite, CNT	1.5	-
Dibutylphthalate, DBP	-	4.5
2-Nitrodiphenylamine, NDP	-	1.5
Potassium nitrate, KNO_3	1.85	-
Potassium sulfate, K_2SO_4	-	1.0
Graphite	0.15	-
* Used by FMI for process development		



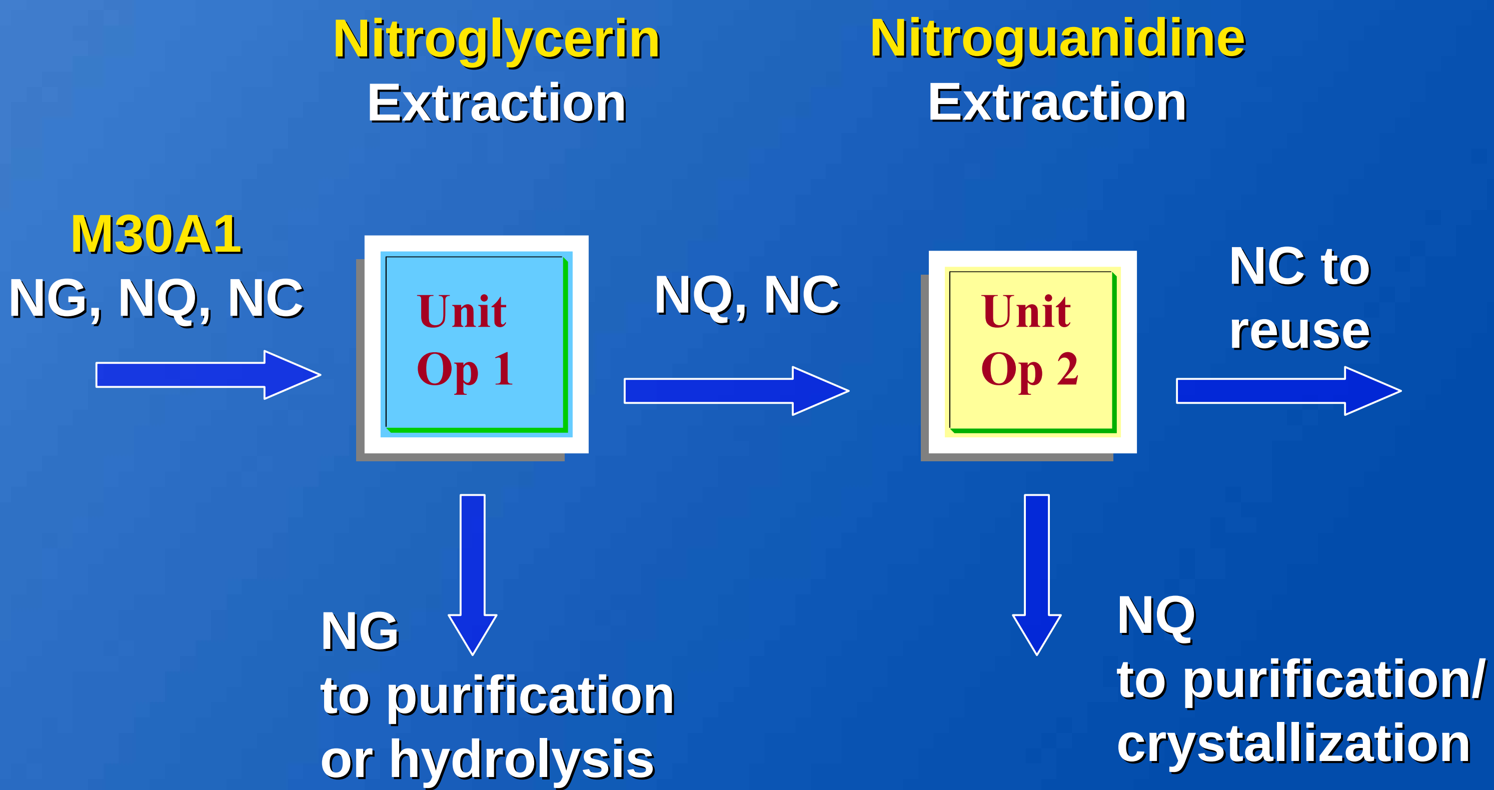


$CH_2ONO_2CHONO_2CH_2ONO_2$



Foster-Miller Solution

Simplified Process Schematic



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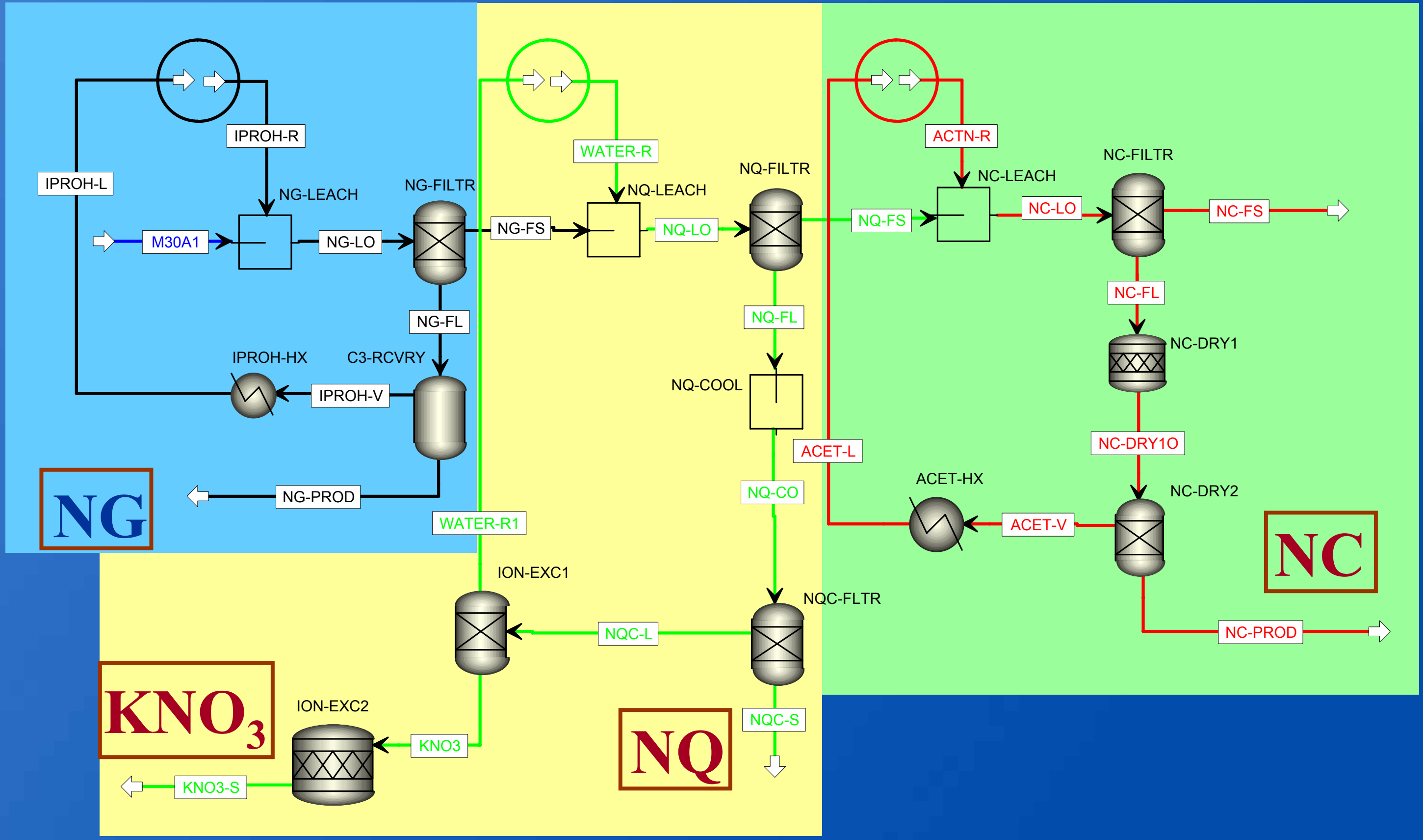
Advantages of Foster-Miller's Solution

- Simplicity
- Safety
- Benign processing conditions
- Non-aggressive reactants
- Operator-friendly
- Recovery of valuable products from hazardous wastes

Foster-Miller Solution
Process Flow Sheet



Nitroguanidine Recovery

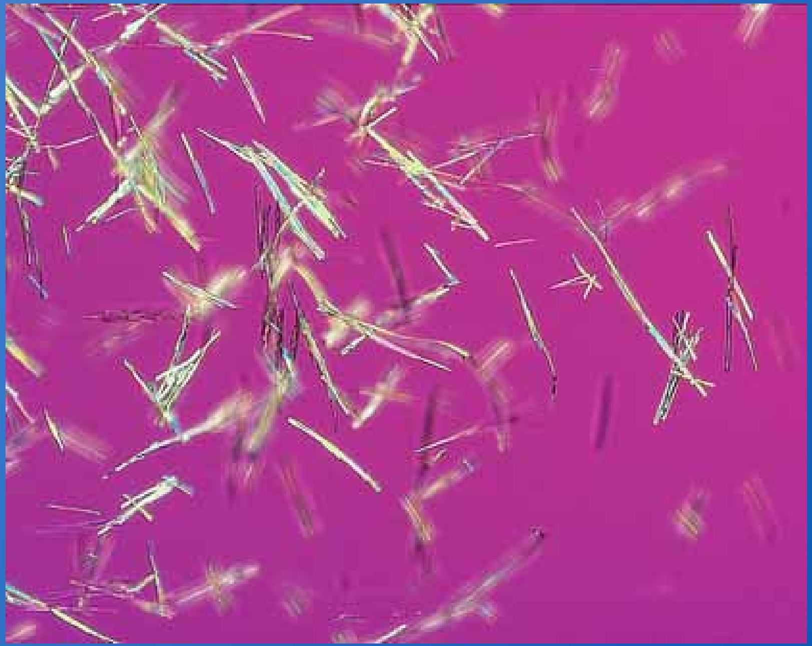
- Recover NQ as a commercially-viable product for propellant manufacture

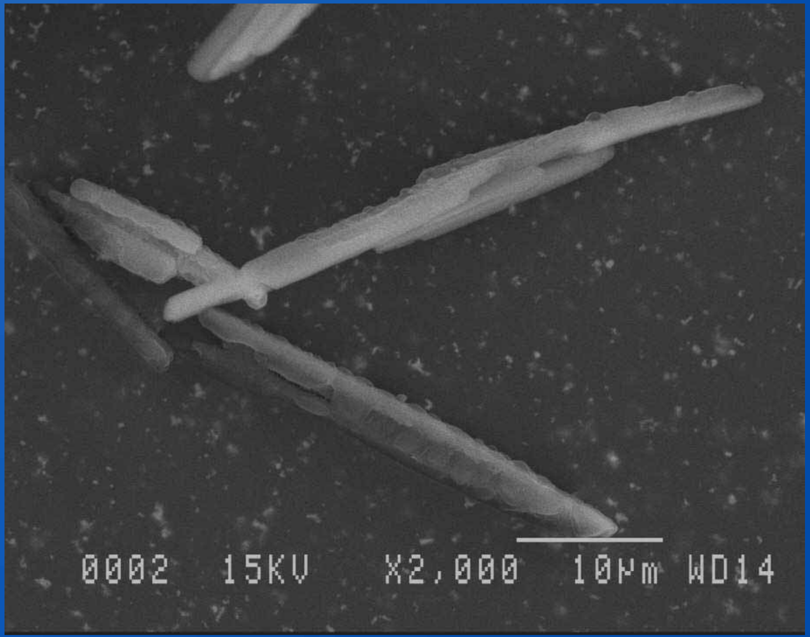
- Military is target market (NQ is currently imported – sole source of supply is undesirable situation)

Post-processing

- Purification and re-crystallization

Nitroguanidine Characterization
NQ Crystals From Commercial Sources





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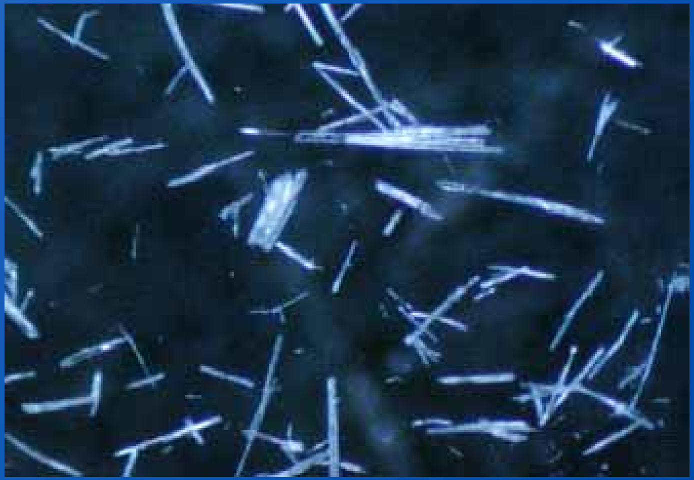
NQ Recovered Via Foster-Miller Process From M30A1 Gun Propellant



Nitrocellulose Recovery

- Recover NC as a commercially-viable product
- Products currently under target industry evaluation
- Potential markets include biomedical and coating industries

Recovered Nitrocellulose Coating Industry Market

Evaluated as a coating ingredient

1. Replacement for high-cost component
   - No adverse effects on performance
2. Additive to existing formulation
   - Significantly increased hardness

Post-processing

1. Cross-link with diisocyanate
2. Adjust viscosity with selected solvents

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Nitroglycerine Recovery

- Recover NG as a commercially-viable product or hydrolyze and discharge to contained landfill
- Commercial markets not yet established
- Potential markets include explosives, medical and organic chemical industries

Foster-Miller Solution Highlights
Past Year

- Dissolution Kinetics
  - Laboratory study
  - Relative extraction rate of each component
  - Amount and temperature of solvents

- Pilot Plant Demonstration (with TPL, Inc)
  - 5 lb batches (30-times scale up)
  - Demonstrate process feasibility
  - Address safety concerns
  - Recover raw products for upgrading studies

Foster-Miller Solution Highlights (continued)
Past Year

- Planning for Large Scale Prototype
  - Working agreement with Gradient Technology, Inc
  - Sourcing funding for commercial-scale demonstration
- Markets for NC, NQ
  - Income source
  - Reduced costs
  - Potential markets for NG

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Dissolution Kinetics Objectives

- Determine the effect on extraction rate of
  - Amount of solvent (slurry concentration)
  - Temperature of solvent
  - Stirring rate
  - Alternative solvents
- Determine relative rates of dissolution
  - NQ losses in NG solvent, etc.
- Product recovery
  - Dissolution time - recovery trade off
  - Re-assess slurry filterability

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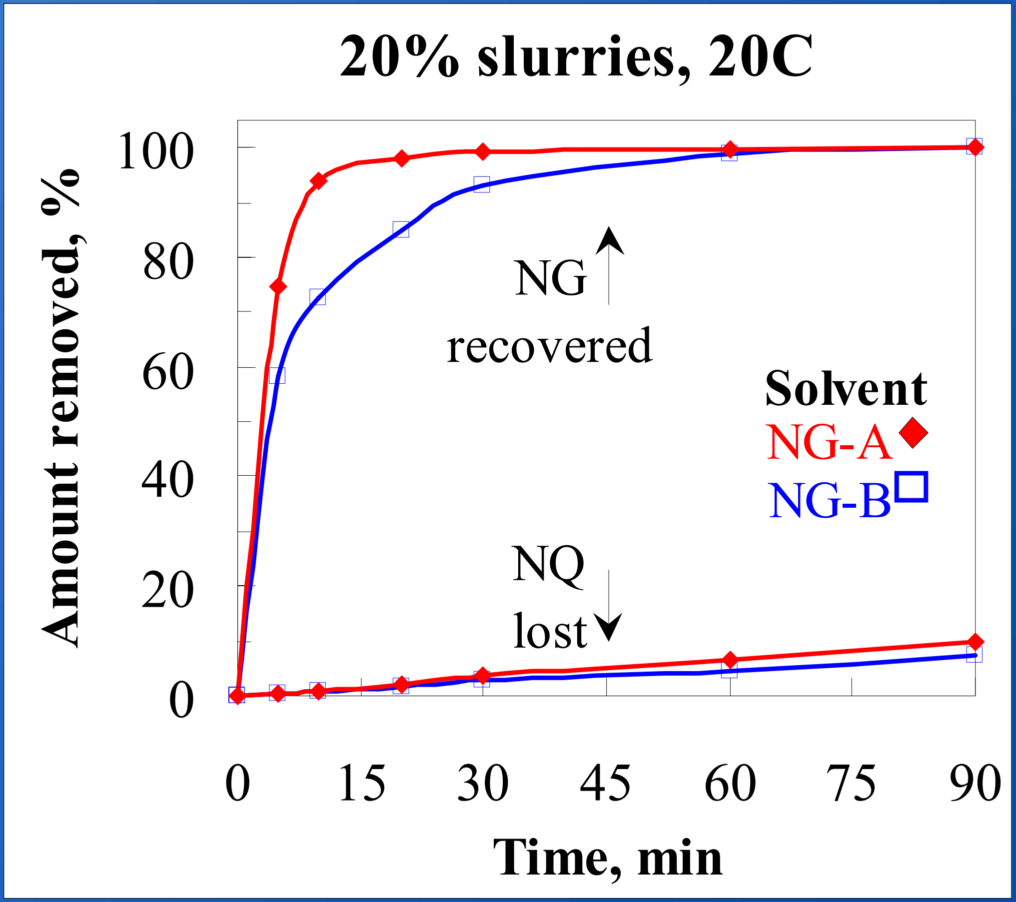
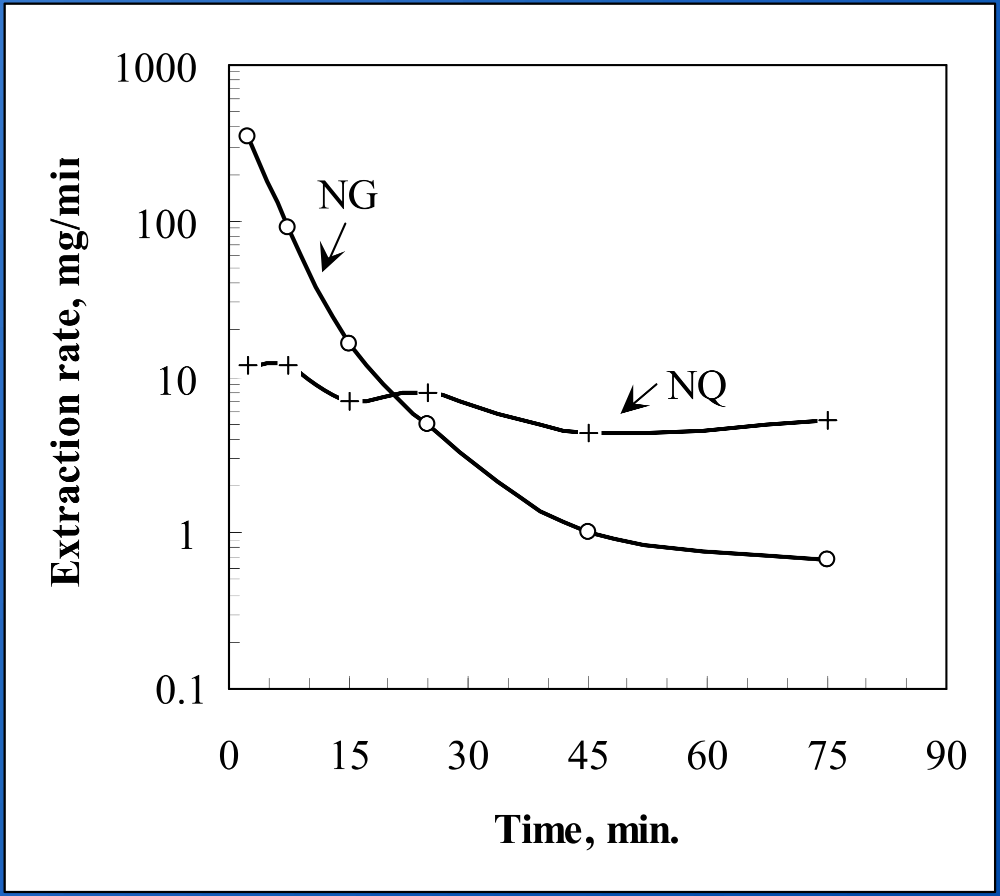
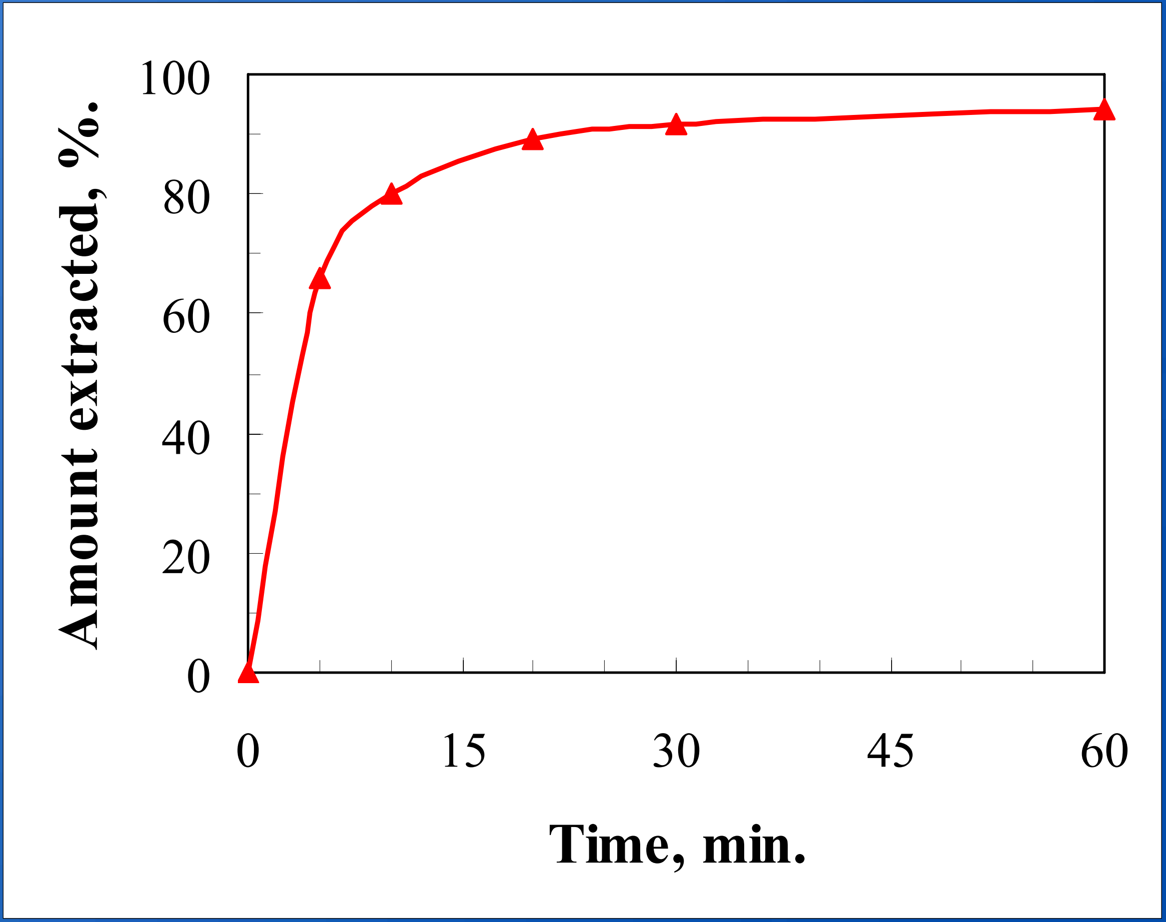
Dissolution Kinetics Results - NG Extraction



Dissolution Kinetics
Results - NG/NQ Extraction Rate



Dissolution Kinetics Results - NQ Extraction



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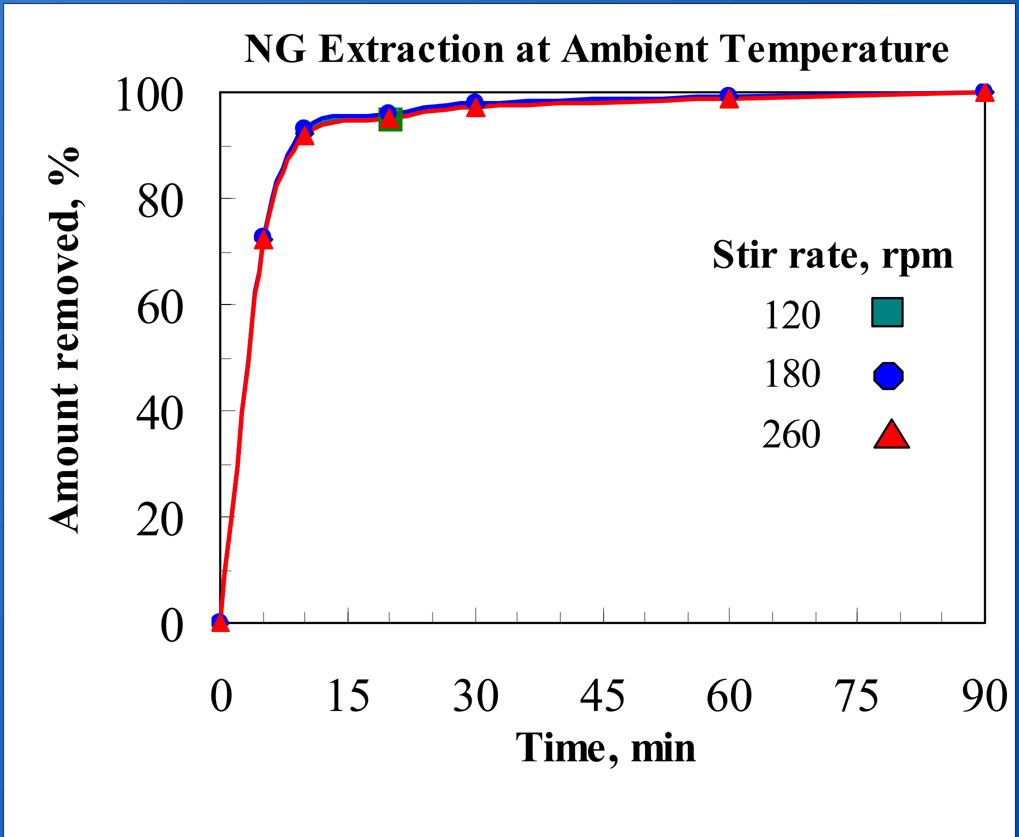
Dissolution Kinetics Results - Stir Rate



Dissolution Kinetics Conclusions

- Virtually all the NG is extracted within 30 minutes with less than 5% NQ loss
- NG can be effectively extracted in a single batch at a high slurry concentration
- More than 98% of the NQ remaining is extracted within 30 minutes
- NG can be effectively extracted in two batches at a moderately high slurry concentration
- Stirring rate has little effect on extraction rate in range investigated (not ΔC limited)

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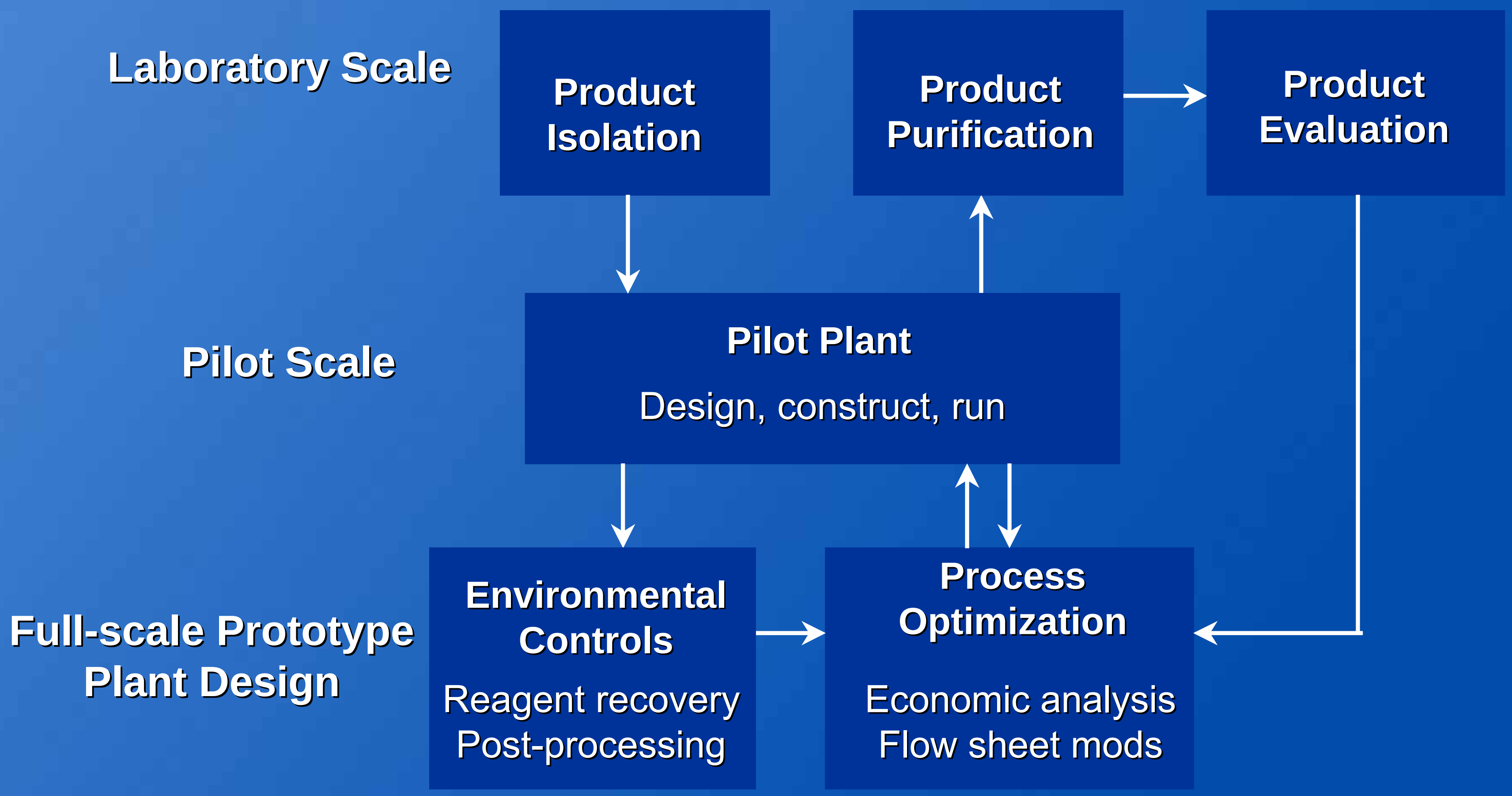
Scale-Up

- The process was originally developed using 1g quantities of gun propellant
- Recovery of energetic materials in the laboratory has been successfully demonstrated on 10g and 75g batches of gun propellant
- Pilot-plant unit designed and built for processing up to 10 pounds per batch

Foster-Miller Approach



Pilot Plant Demonstration Objectives

- Demonstrate Foster-Miller's Demill Process
  - At 5 to 10 lb scale (30 to 60 times scale-up)
- Show feasibility of FMI extraction concept
  - Recovery of each component
  - Determine yields, losses, contamination at large scale
  - Identify potential scale-up problems
- Obtain supply of raw products
  - For developing post-processing methodology
- Demonstrate process safety

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Pilot Plant Demonstration

Battelle
The Business of Innovation

Acid Digestion Process For Unexploded Ordnance:

Insensitive Munitions

14th Global Demilitarization Symposium

1-5 May, 2006

Indianapolis, IN

Presenter:

Ed Groth

Contributing Authors:

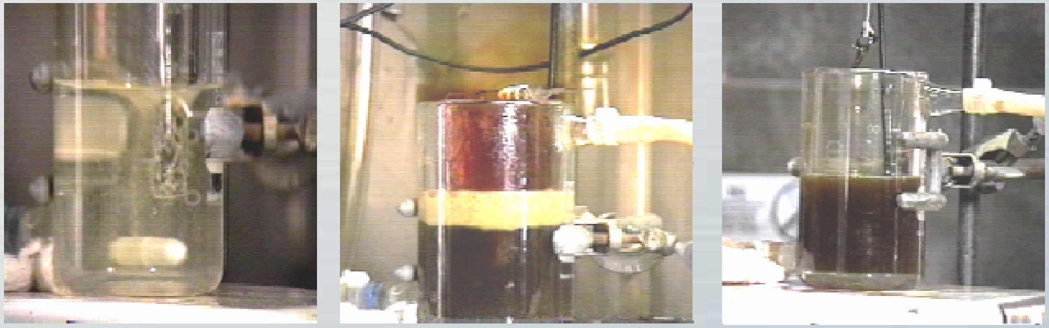
Mr. Dennis Wynne
Mr. Christopher Livingston
Mr. Steve Mullins (Booz Allen Hamilton)

Acid Digestion Process

Background

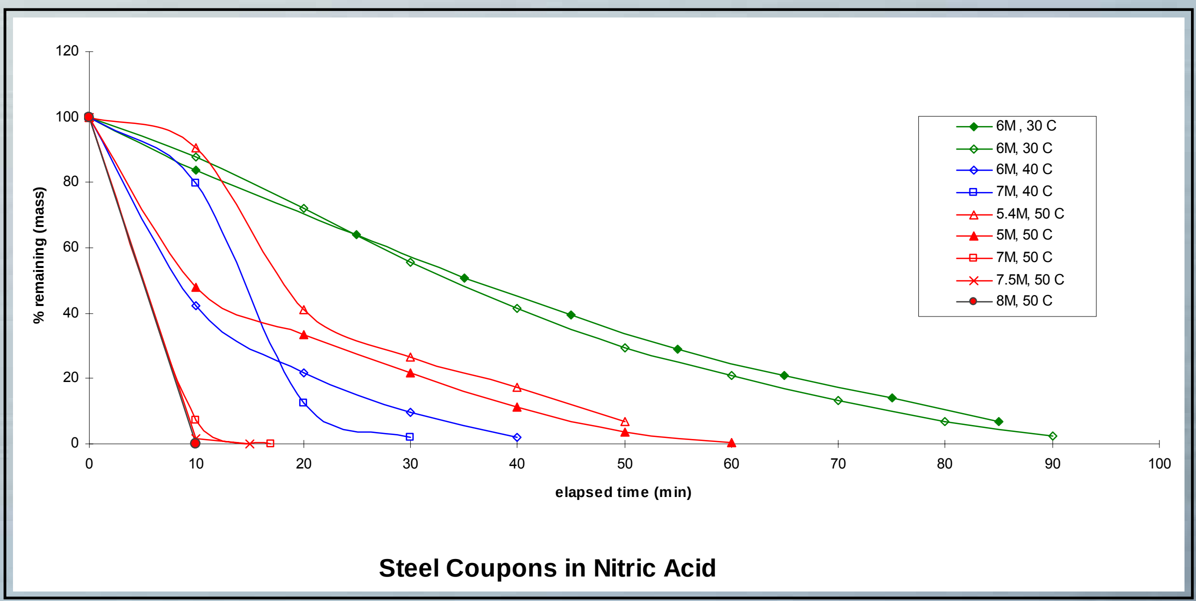
- Originally designed to meet chemical demilitarization need.
- Whole munitions are dissolved using acid.
- Chemical fills are neutralized.
- Explosives recovered for reuse or treatment.
- Metals are recoverable.
- Acid recoverable and recyclable.
- Seeking user input for broader application of the technology.

Conceptual Testing - Acid Optimization



Lab Studies

Explosives Testing



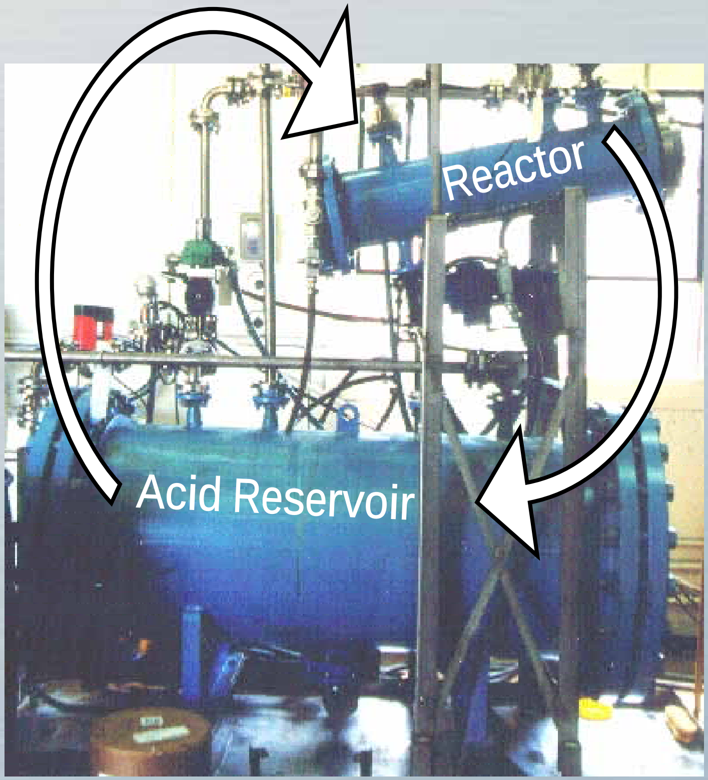
Coupon Testing

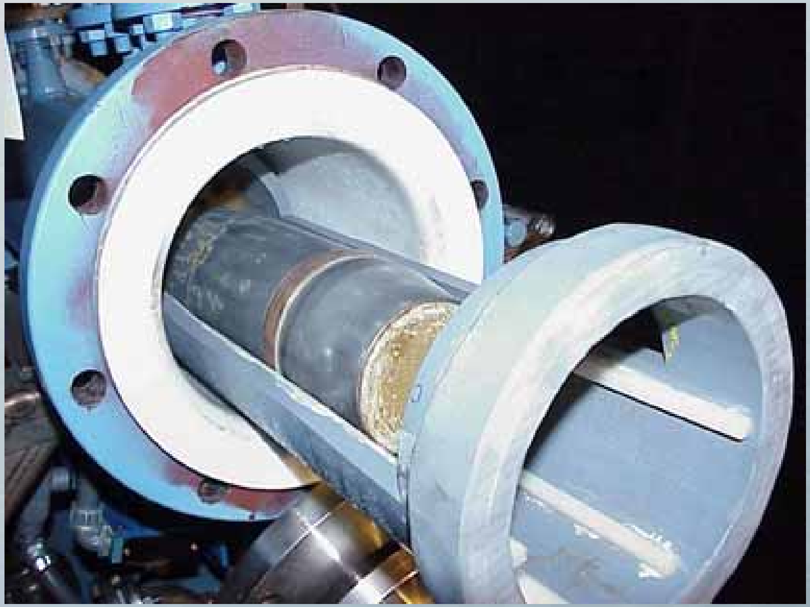
Battelle
The Business of Innovation

Acid Digestion Process
Pilot Scale Demonstration Unit

Operation

- Place munition in reactor.
- Seal reactor.





- Circulate acid
- Reaction time is dependent upon the target item (wall thickness, fill type, condition of the item, etc).

Acid Digestion Process
Initial Testing – Proof of Concept

Before

After

23 mm High Explosive Incendiary Cartridge

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Acid Digestion Process

Proof of Concept

105 mm Chemical Projectile Before And After Processing

Acid Digestion Process
Broad Scope of Applications

Energetic Material

Pilot Scale:
- Lead styphanate
- Lead azide
- Mercury fulminate
- Black powder
- Double base propellant
- Flash powder
- Barium chromate/zirconium
- TNT
- RDX
- PETN
- Dinitrobenzene
- Hexanitrodiphenylamine
- Picric acid
- Dinitrotoluene
- HBU-88B

Bench Scale:
- PBXN-109
- AFX-757

Chemical Fills

Bench Scale:
- Diphosgene (DP)
- Tin tetrachloride (smoke)
- Sulfur trioxide (smoke)
- Chloropicrin (PS)
- Nerve agents VX & G series
- Arsinöl
- Nitrogen Mustard (HN)
- White Phosphorus (smoke)
- Red Phosphorus (smoke)

Pilot Scale:
- Hydrogen cyanide (AC)
- Phosgene (CG)
- Mustard (Kampfstoff LOST)
- Oleum (FS)
- Arsenic trichloride (smoke)
- Ethyl Iodoacetate (SK)
- Arsine (SA)

Munitions Treated

Inert Munitions

– 75mm to 105mm

High Explosive Munitions

– 23mm to 120mm projectiles and bomblets

Fuzes

– Armed and Unarmed

Chemical Cylinders

– CG

Recovered Munitions

– 75 mm to 114mm toxic and smoke fills

Insensitive Munitions Testing

ARDEC/Battelle Feasibility Testing

- Future Stockpile Will Be Predominantly Insensitive Munitions (IM).
- IM Disposal Challenges.
  - IMs will require demilitarization in out years.
  - Presence of perchlorates cause deterioration of fire bricks in current incinerators.
  - Inability to remove explosives from munitions bodies precludes melt out.
  - Incineration or bang boxes allow for recovery of metals, but not explosives.
  - Bang box life span degrades as IMs burn hotter than conventional explosives.
  - Mechanical removal of base detonating fuzes and removal of explosive fill by drilling, CO_2 pellets, or water jet is slow and has inherent safety issues.
- Demil Group Focus
  - R3
    - Recover Metals, Recover/Reuse Explosives, Recycle Waste to Product

ARDEC/Battelle IM Study

Purpose:

To determine how thermoset, cast-cured explosives behave in 7 Molar (M) nitric acid.

Two Phases: Bench Scale and Pilot Scale

Phase 1- Bench Scale

- **Identify explosive mixtures found in IM.**
- **Conduct bench-scale beaker testing of selected explosives to determine preliminary effects in 7M nitric acid.**

Phase 2- Pilot Scale

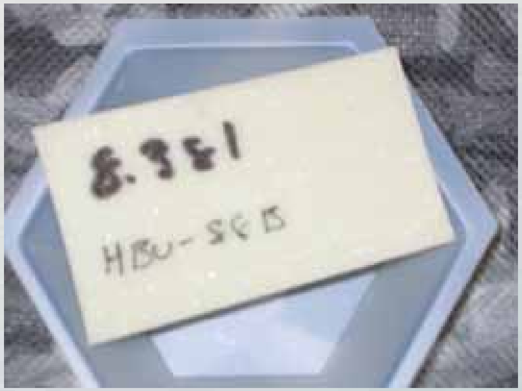
- **Pilot Scale Demonstration – Digest a 120mm mortar containing HBU-88B in the ADP prototype unit.**

Bench Scale Testing

Test Scenario

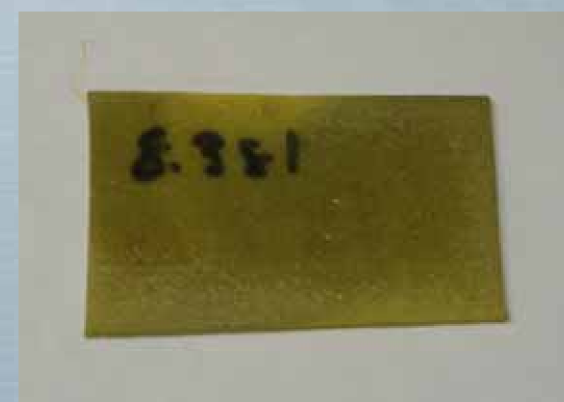
- Explosive samples were weighed before and after testing.
- Samples were exposed to 60°C, 7M nitric acid containing representative amounts of iron (simulating digestion of munition body).
- Beaker testing continued at ~ 60°C for 1 hour.
- Samples were dried per Battelle methods.

Bench Scale Testing – HBU-88B



HBU-88B Prior to HNO_3 Exposure

Reaction Mass During Beaker Test



HBU-88B Following HNO_3 Exposure

Bench Scale Testing – HBU-88B

Granular RDX was tested as a control to help distinguish if the explosive or binder was dissolving, should the HBU-88B exhibit dissolution.

FILL MATERIAL	INITIAL TEMP OF HNO_3	PEAK OBSERVED TEMP	PRE-REACTION MASS OF EXPLOSIVE	POST-REACTION MASS OF EXPLOSIVE	CHANGE IN MASS	COMMENTS
HBU-88B	64ºC	64ºC	8.4 grams	8.4 grams	0.0 grams	No observed reaction.

Beaker testing showed that Battelle's Acid Digestion Process is compatible with the tested HBU-88B. Operators observed no visible reactions during testing, and the HBU-88B did not dissolve.

Based on these results, Battelle continued with the pilot scale testing of a 120mm HBU-88B mortar in the ADP demonstration unit.

Pilot Scale Testing
Set Up

Pilot Scale Testing
Results

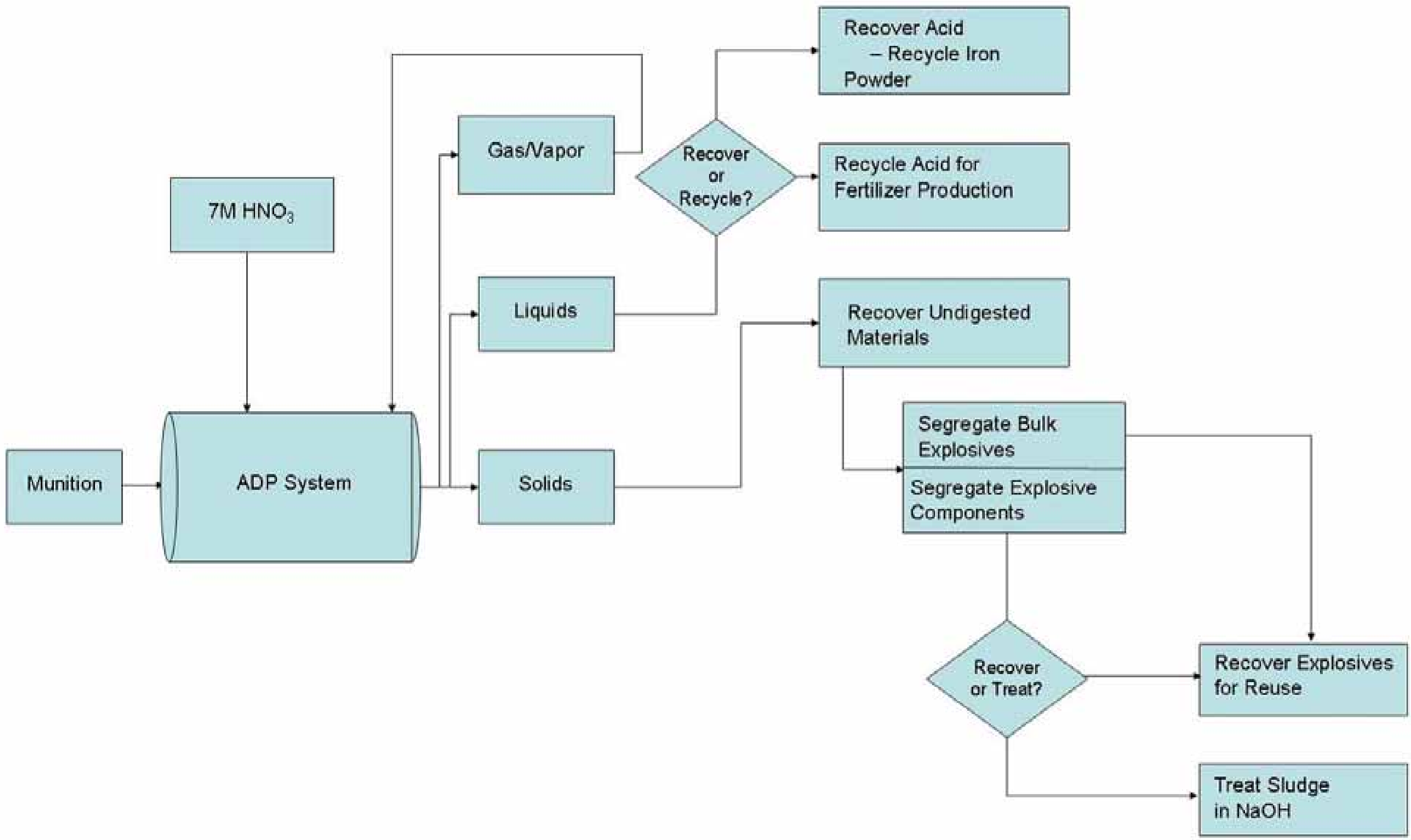
120mm Mortar Prior to Acid Digestion

120mm Mortar Following Acid Digestion

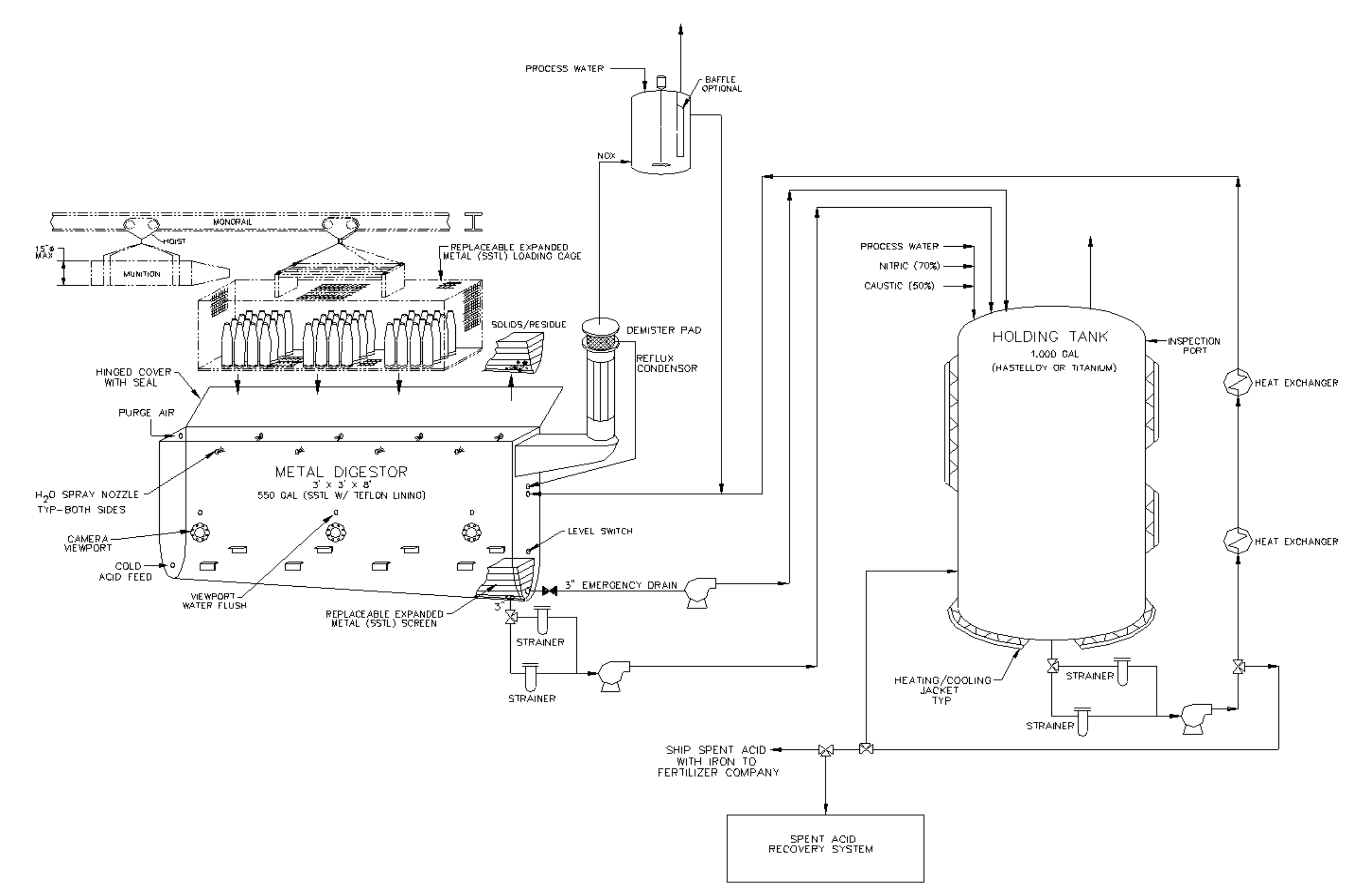
Pilot Scale Testing

- **A sample of the acid digestion waste stream was collected and analyzed for RDX, the main component of HBU-88B.**
  - The analysis consisted of 3 processed nitric acid and 3 water rinse/nitric acid samples for the presence of RDX using HPLC/UV
- **Analysis of the three nitric acid samples resulted in concentrations of 89.7, 89.4, and 90.7 ug/mL (ppm).**
  - An analysis of the highest concentration (90.7 ug/mL) shows that the amount of HBU-88B found in the waste stream is ~ 0.008% of the total liquid waste stream, and represents ~ 0.34% of the initial mass of the HBU-88B (~3kg).

Future Applications – Concept
Acid Digestion Process Flow



Conceptual Design Drawing of Scaled-Up ADP Process Flow



Battelle
The Business of Innovation

Summary

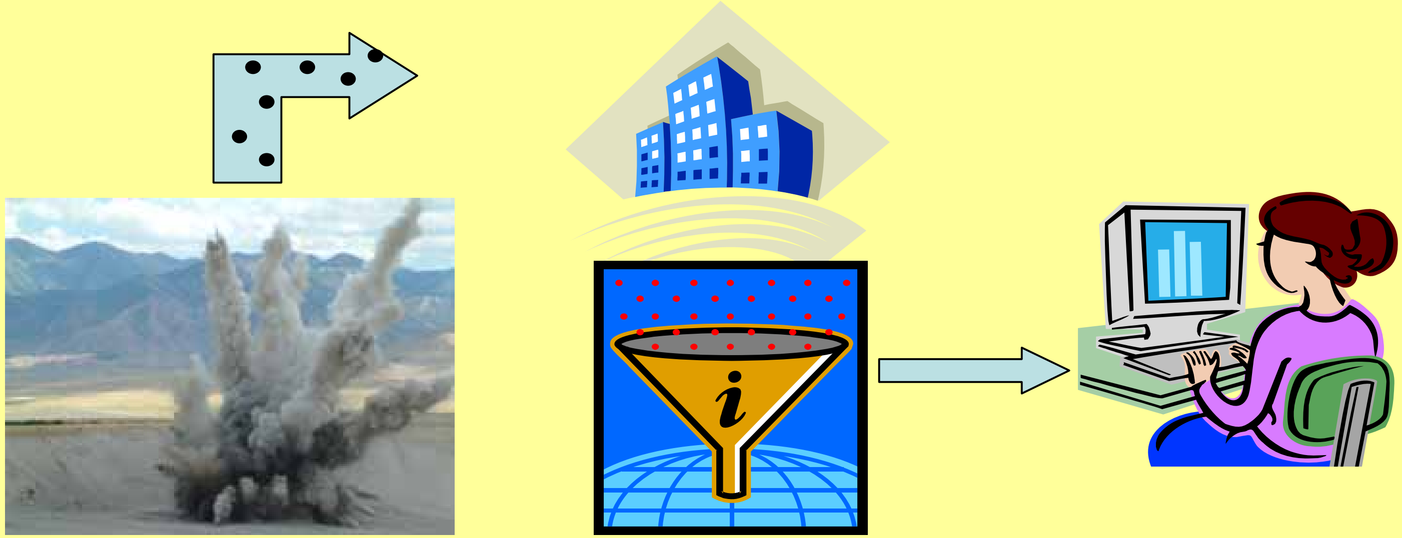
Pilot Scale
IM Disposal Feasible

Bench Scale
Smokes/Incendiaries Feasible

R3
Recover/Reuse Explosive
Recover Metals
Recycle Waste to Product

Scalable
Sized to Specific Item
Sized to Specific Mission

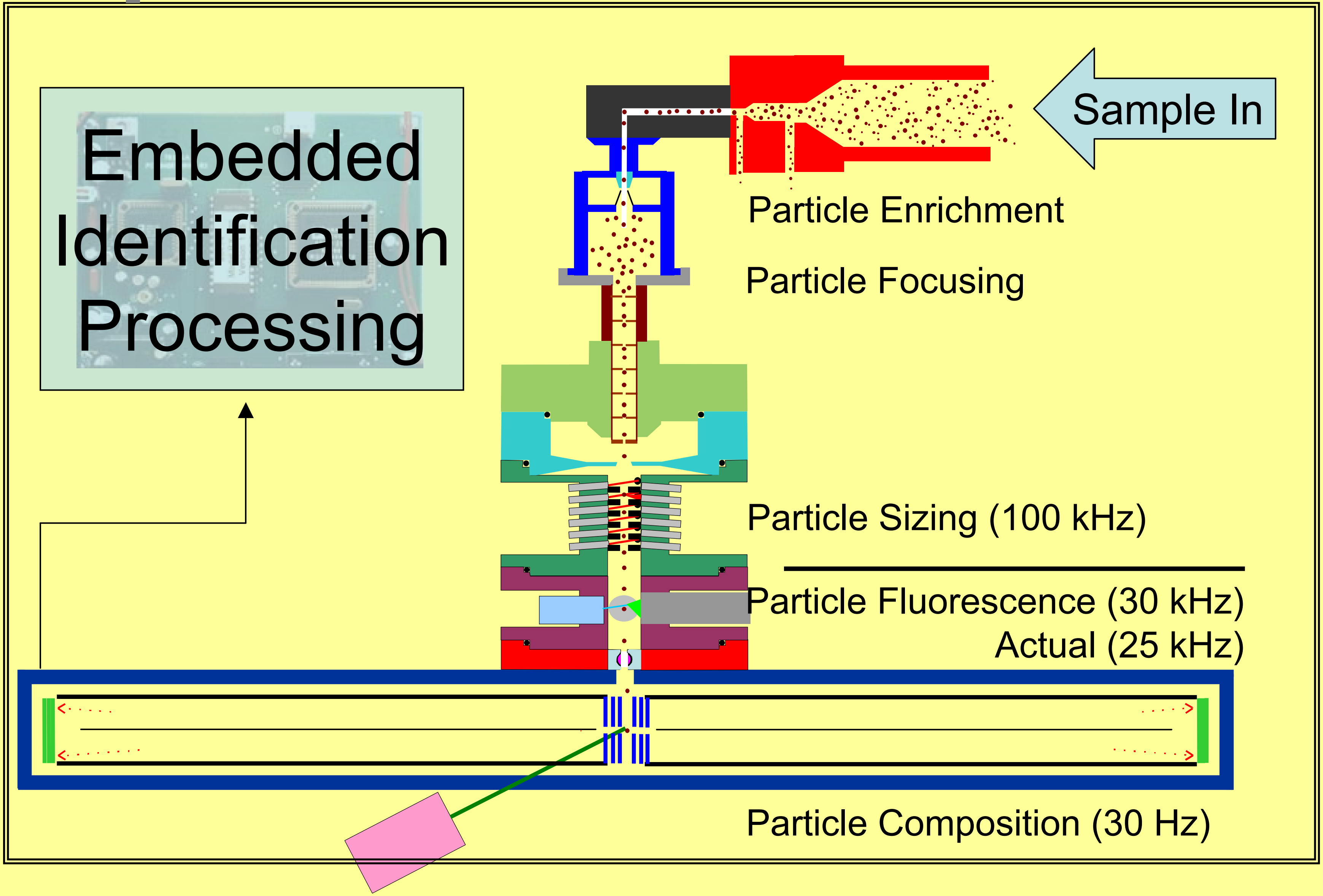
Requesting User Support For Scale-up
From Bench Scale To Pilot Scale Plant/Test



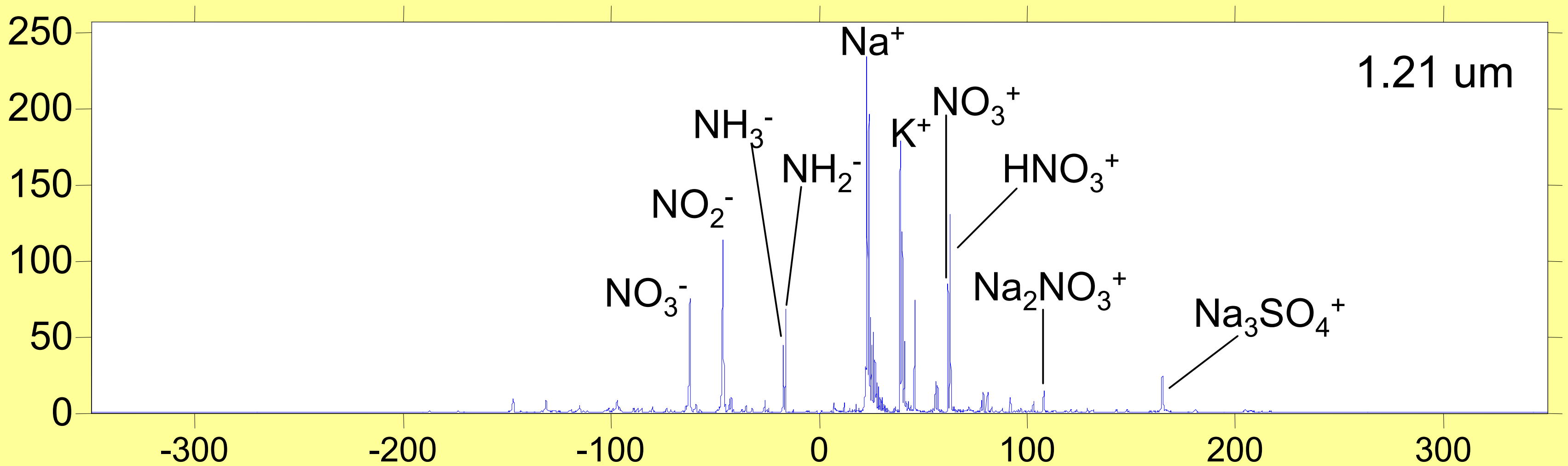
Instantaneous Detection of Particles Liberated by Open Detonation Treatments

Dr. David P. Fergenson and Dr. George R. Farquar
Lawrence Livermore National Laboratory

Particle Analysis by Mass Spectrometry (PAMS)

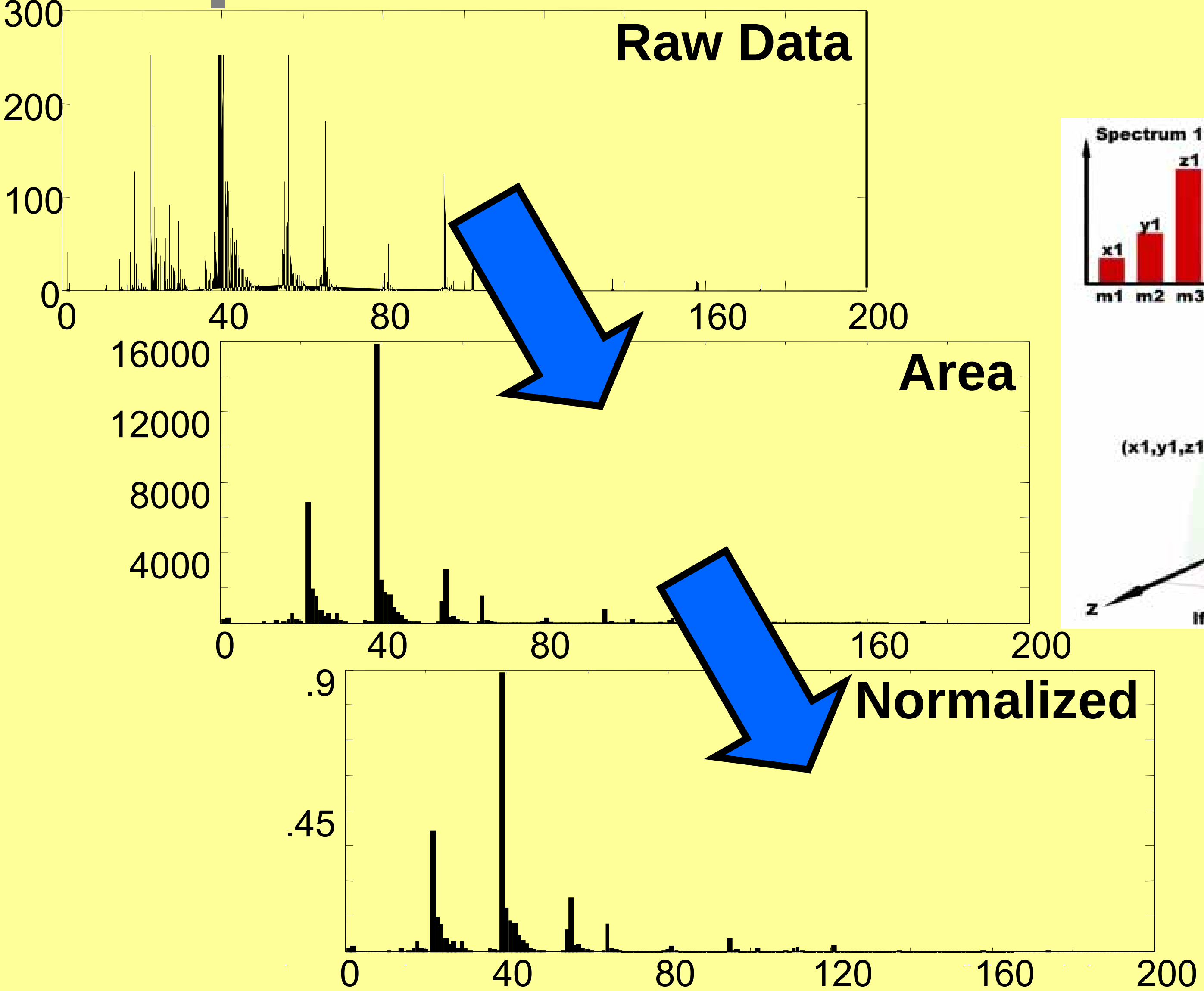


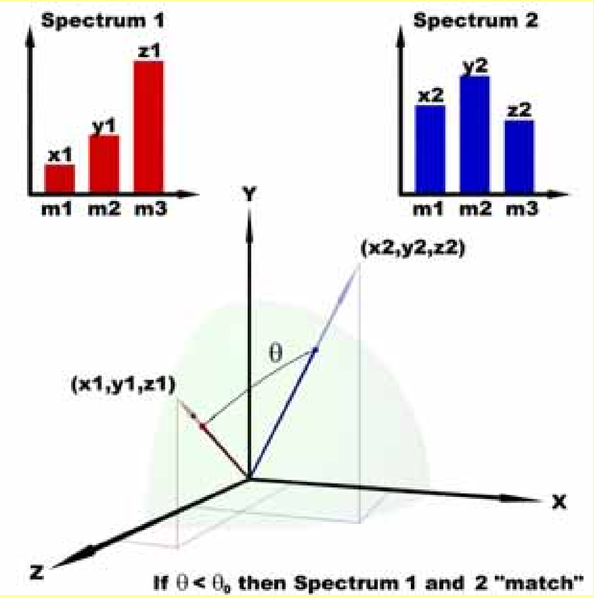
Example of Single Particle Data



- Two complete mass spectra from each particle
- Size and composition returned in real time
- Data analysis can be performed in real time as well

Data Analysis

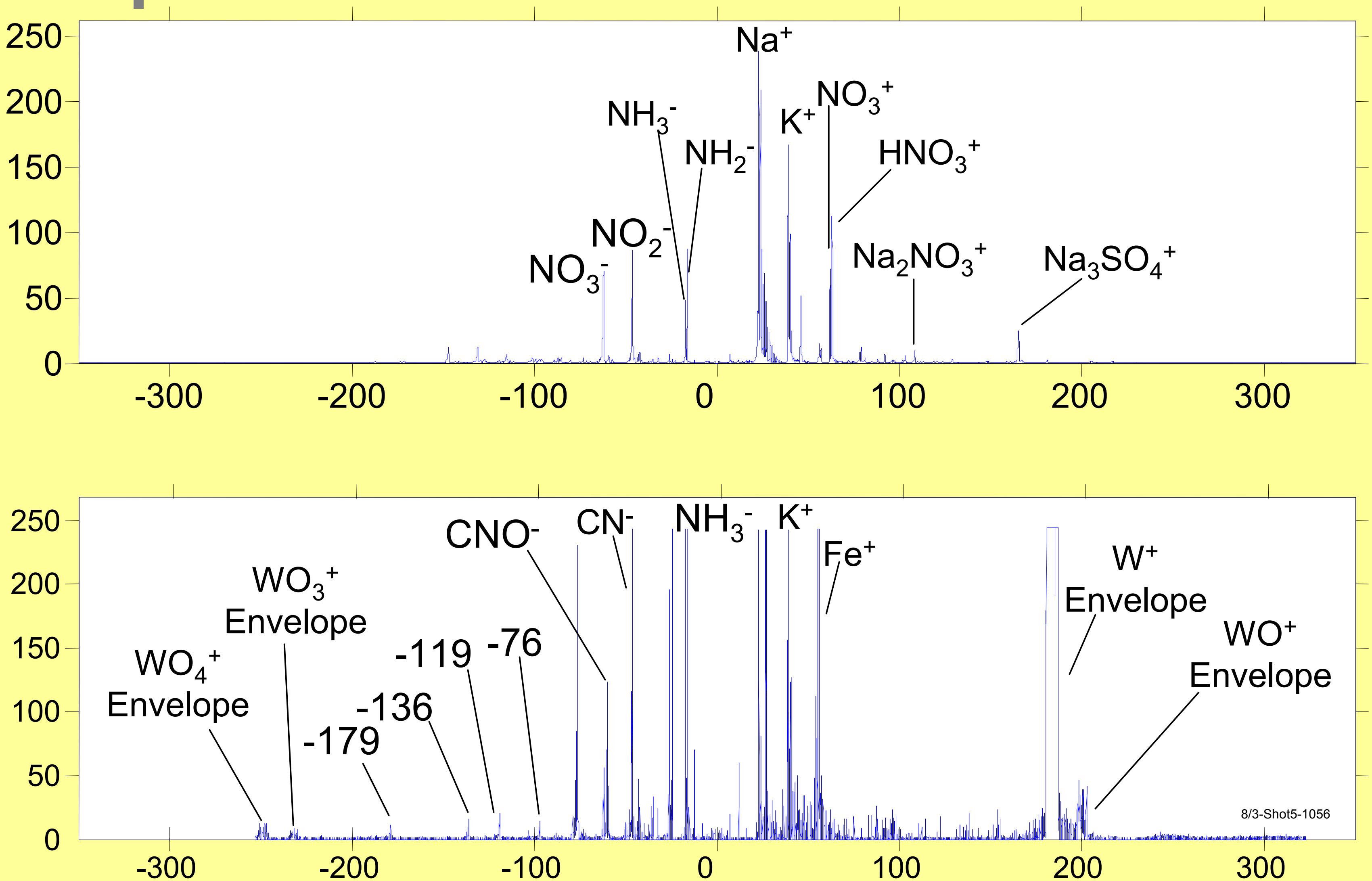




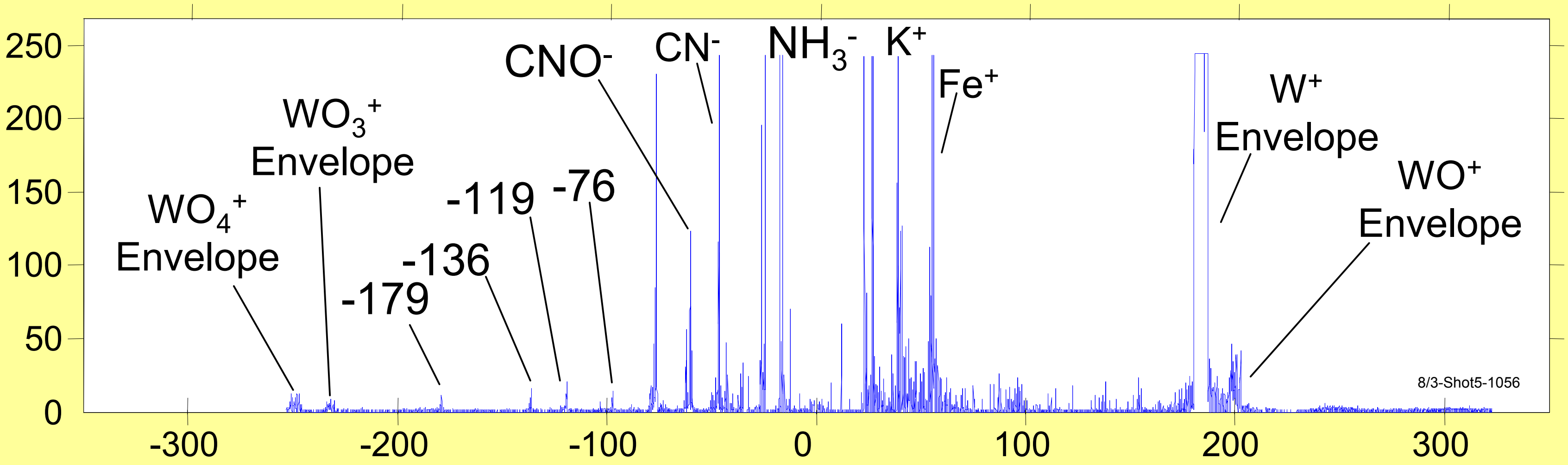
Proving the Concept

LLNL Site 300, Bunker 850

Site 300 Background/Post Shot



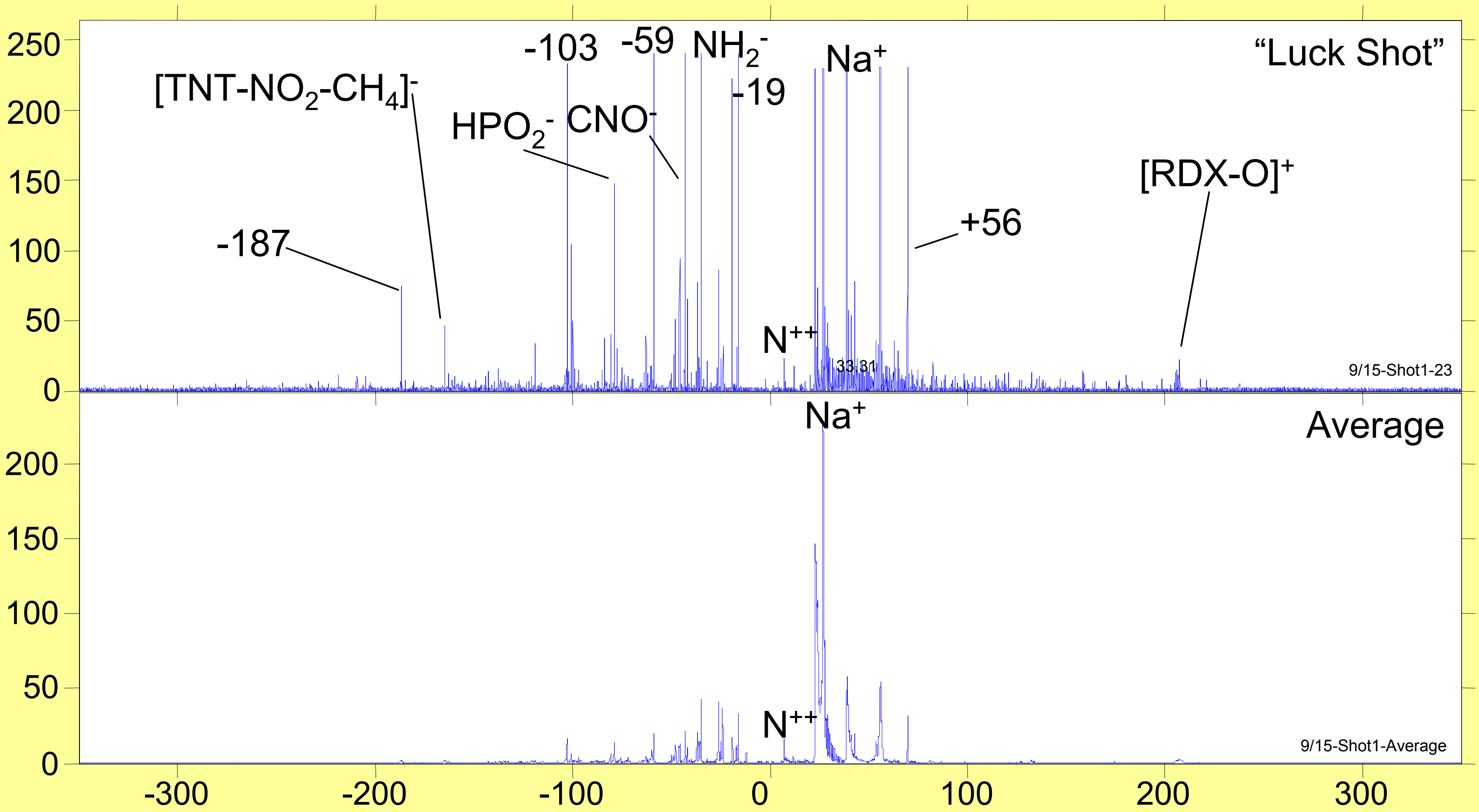
45% of Post Det Spectra Contained W



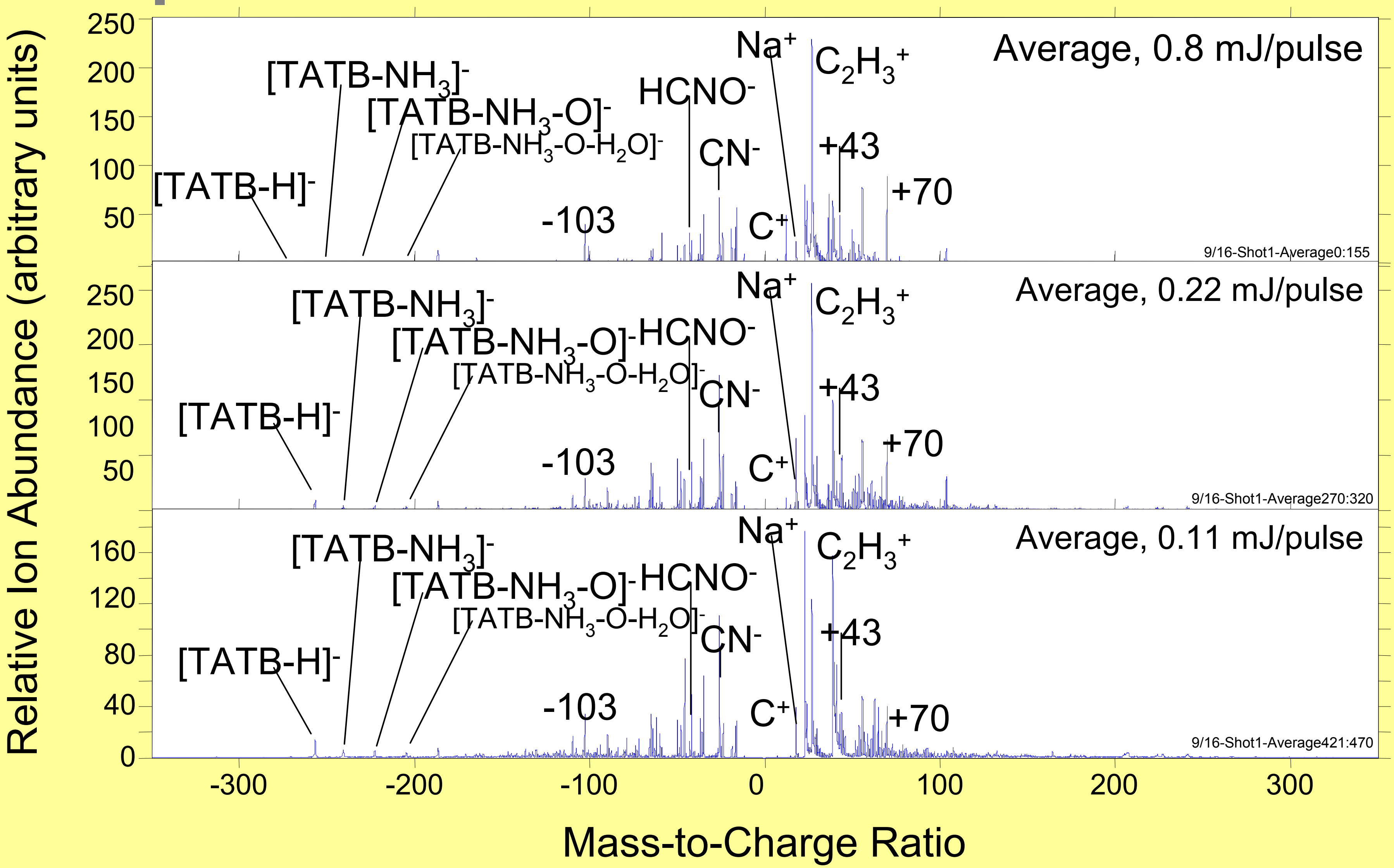
The BAMS at HEAF

150 mg TNT and LX-17 charges.

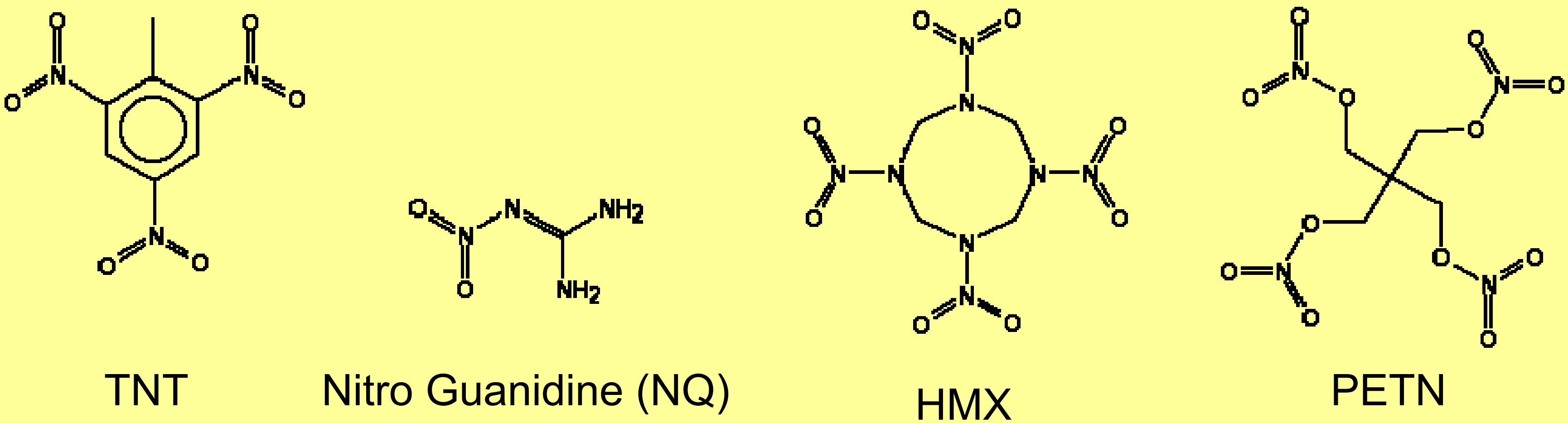
Comp B, 0.9 mJ/Pulse

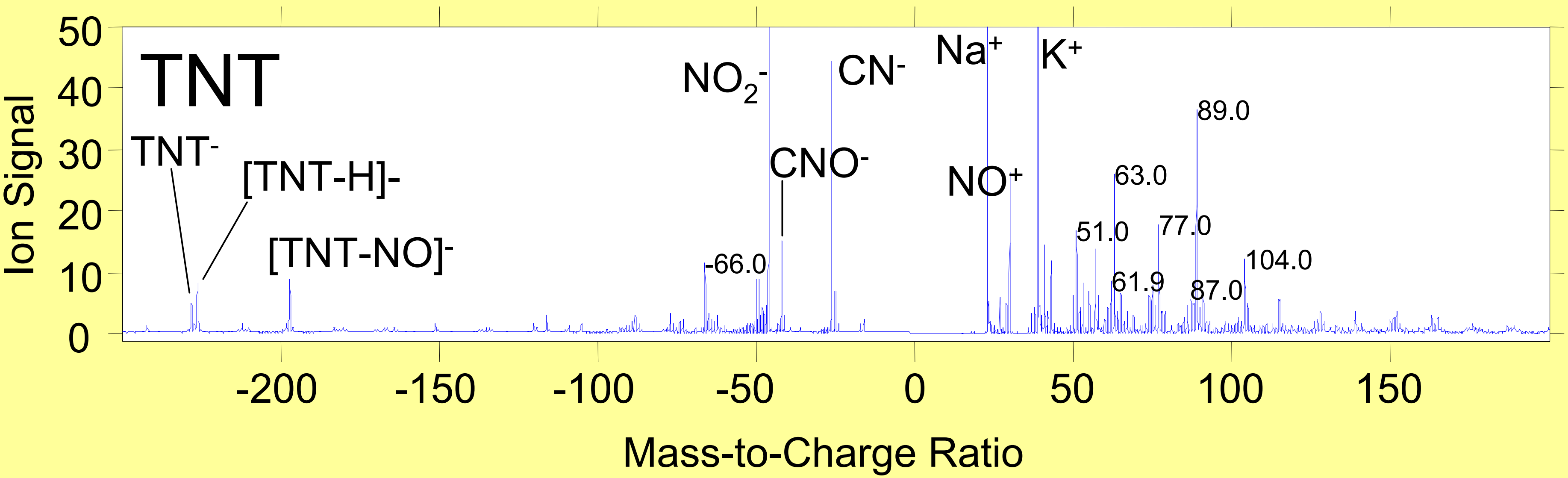


LX-17, Decreasing Laser Power

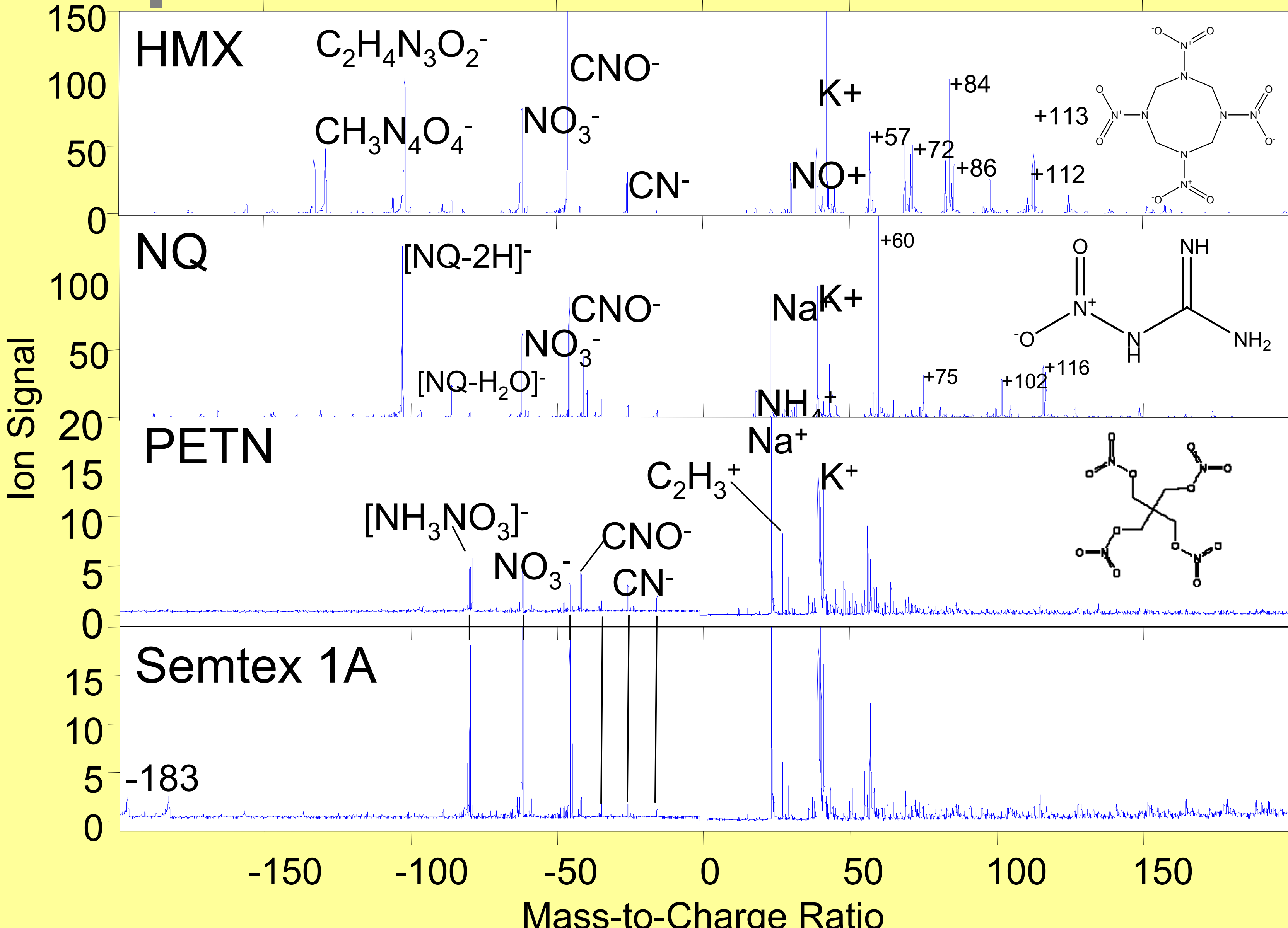


Expanding the Library: Explosives





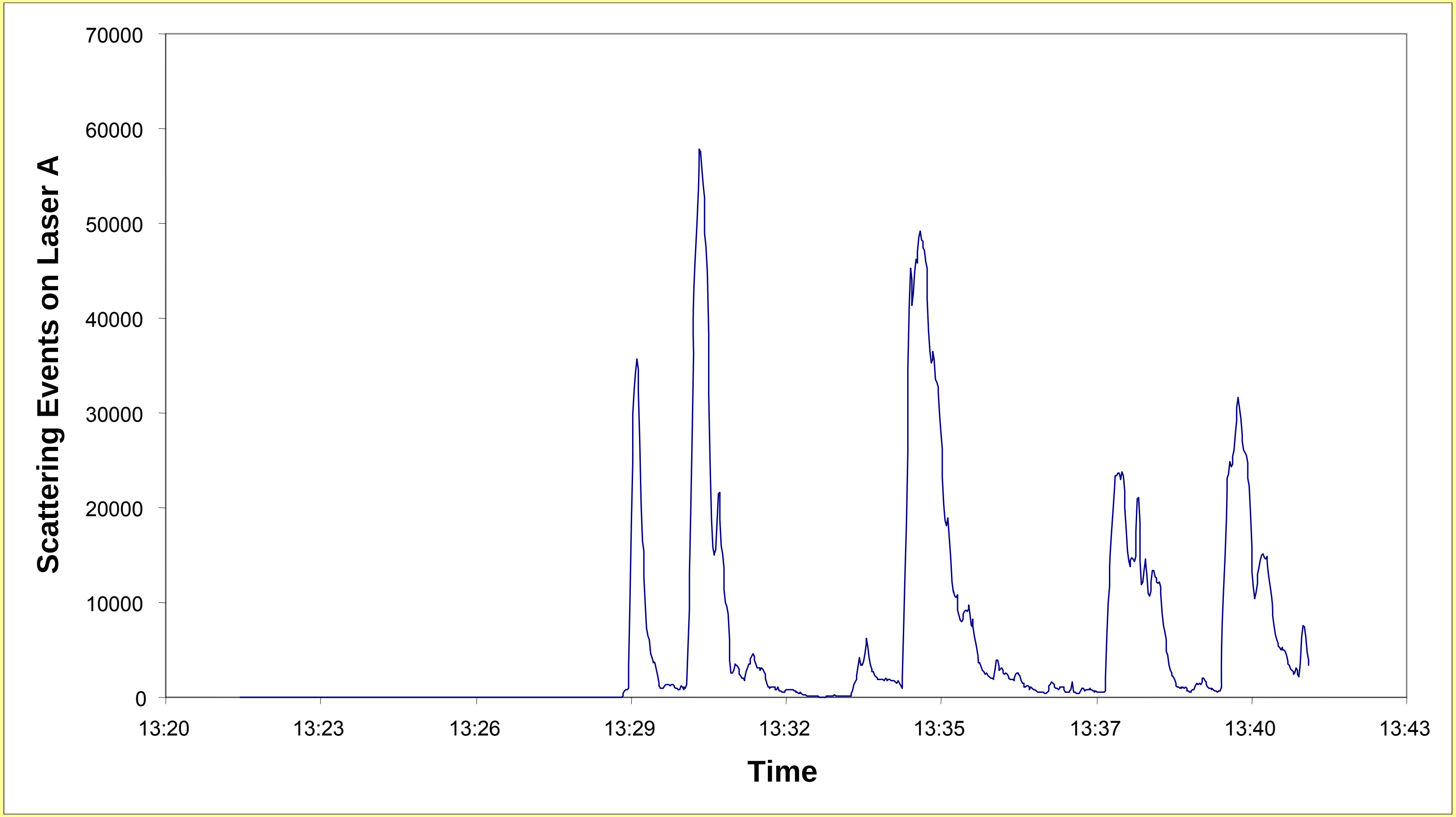
Other High Explosives



Field Testing

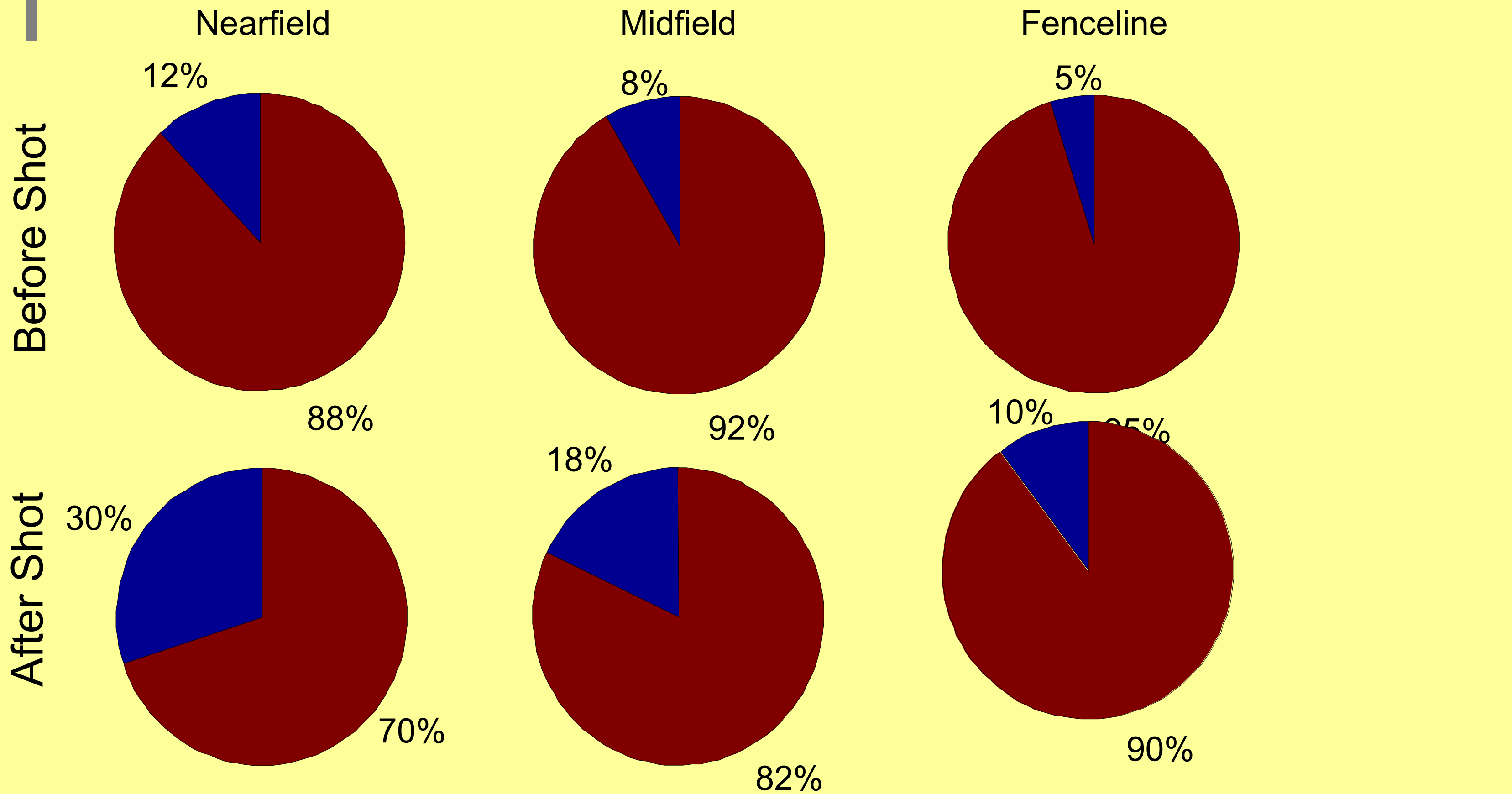
- <u>ONLY QUALITATIVE DATA</u>
- TEAD
- 800 lbs NEW
- Comp B/TNT
- 3 distances
  - 70 M
  - ~200 M
  - Fenceline

Plumes



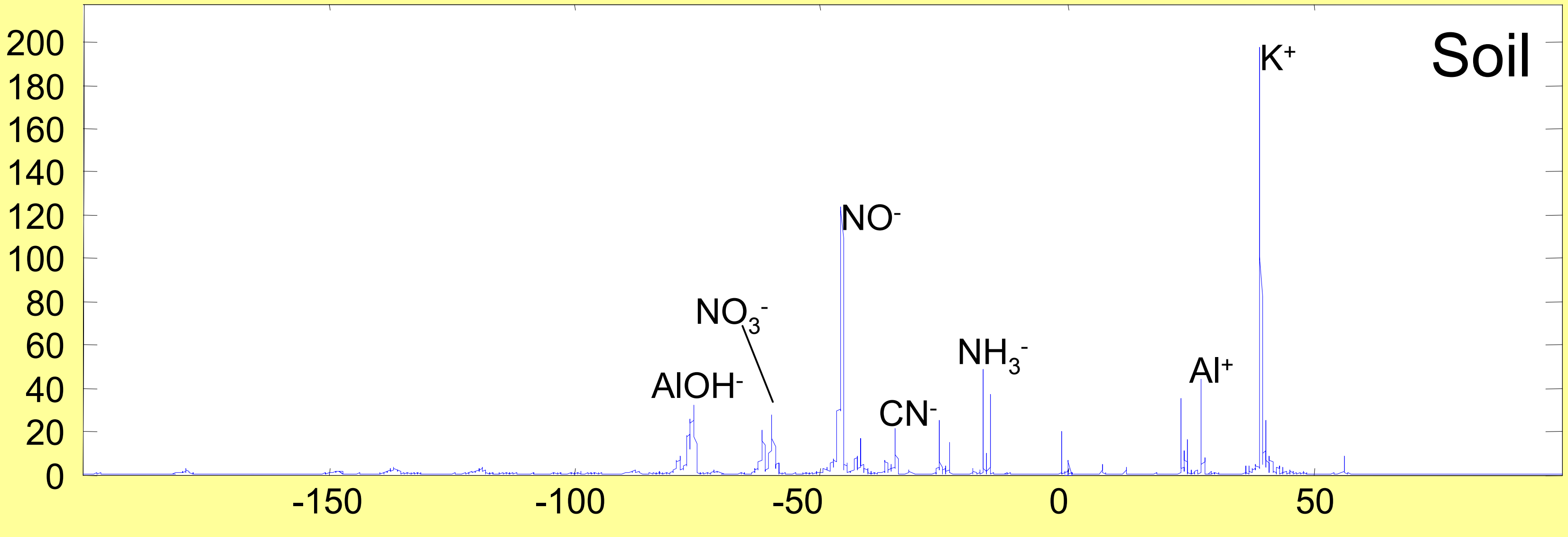
Scattering Events on Laser A
70000
60000
50000
40000
30000
20000
10000
0
13:20
13:23
13:26
13:29
13:32
13:35
13:37
13:40
13:43
Time

Identified Soil Particles

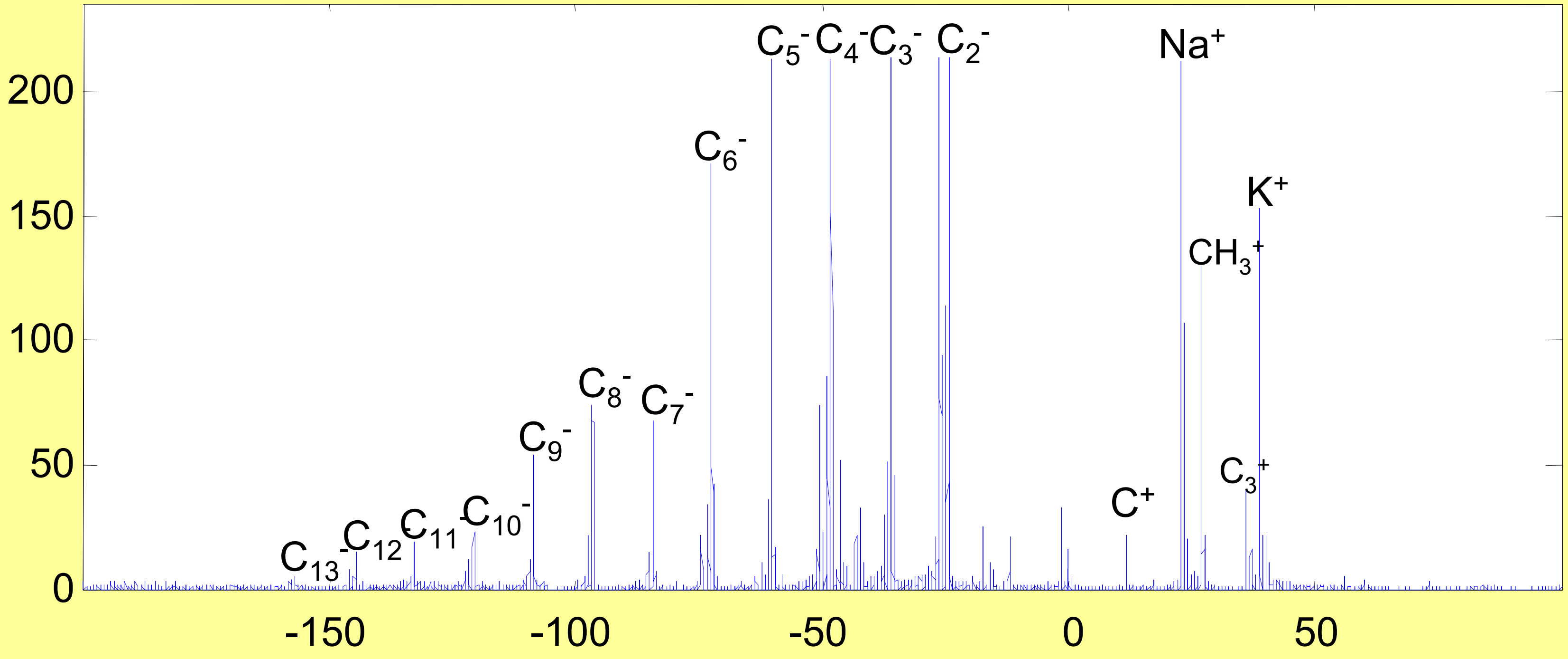


Near Field Data: 70 Meters

- Background: 1456 Spectra over 21 minutes
- Shot Spectra: 1365 Spectra over ~2 hours
  - Different sampling inlet
- Major Clusters Present:
  - Soil, Soot, Ammonium Nitrate with Salts

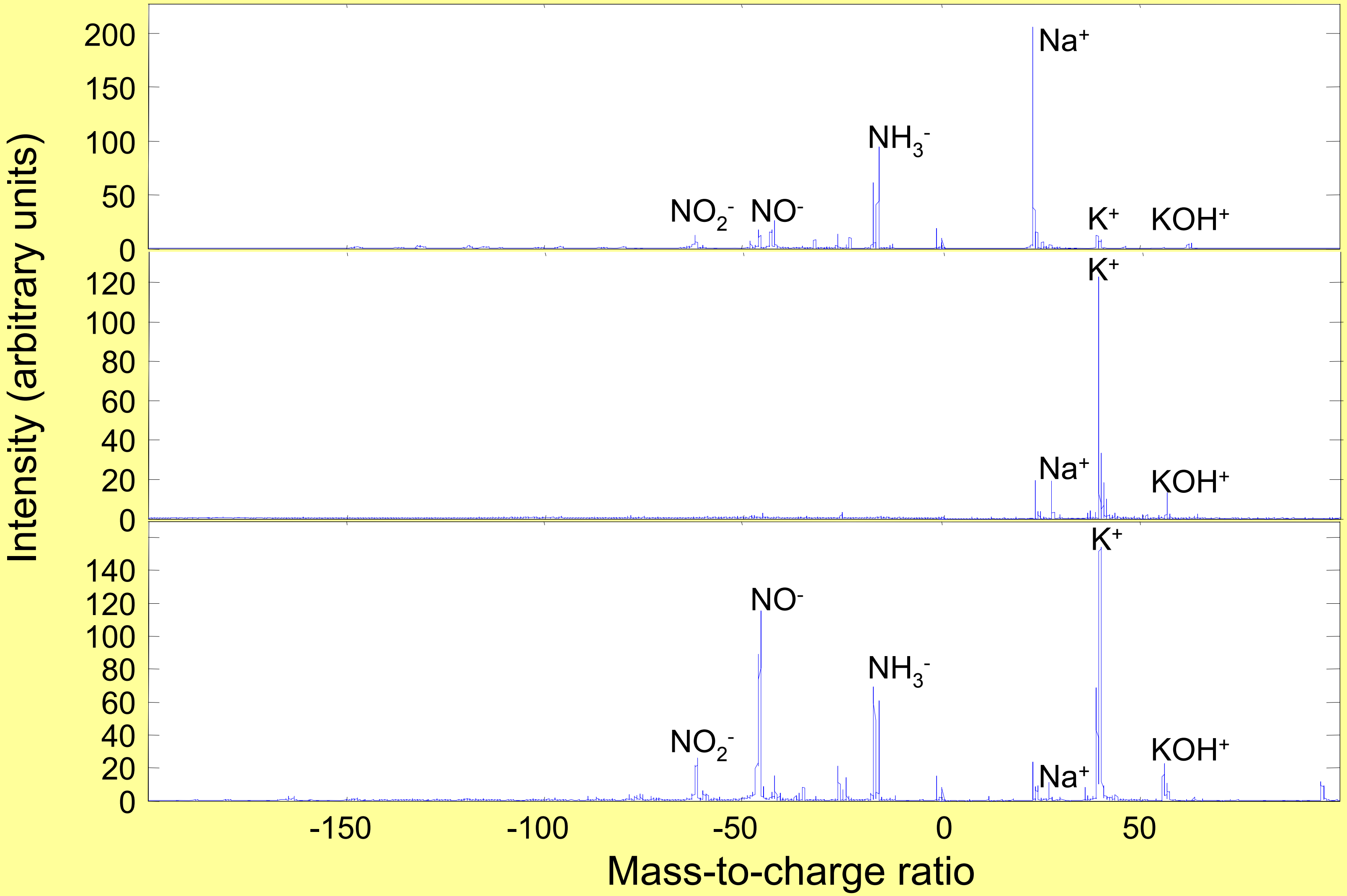


Soot

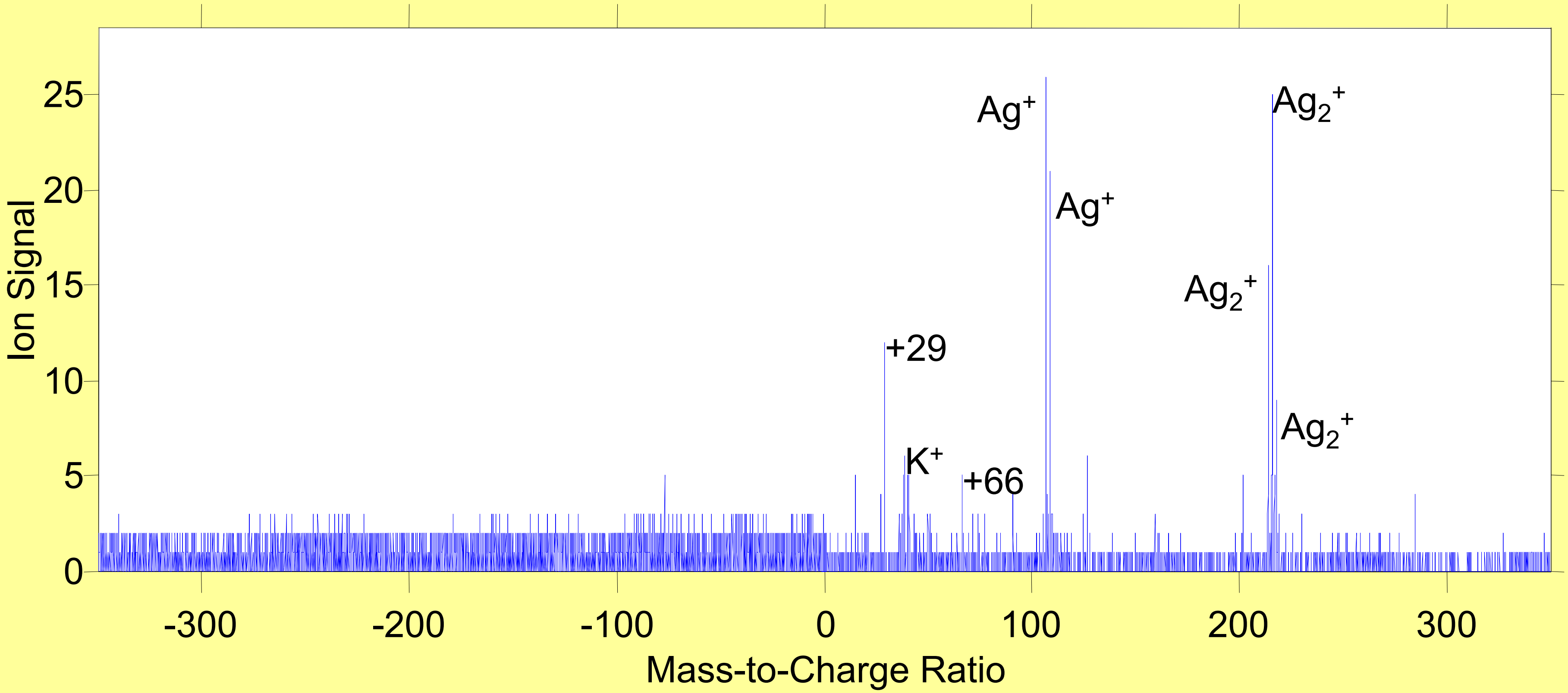


C_5^-
C_4^-
C_3^-
C_2^-
Na^+
C_6^-
K^+
CH_3^+
C_8^-
C_7^-
C_9^-
C_3^+
C^+
C_{10}^-
C_{11}^-
C_{12}^-
C_{13}^-
200
150
100
50
0
-150
-100
-50
0
50

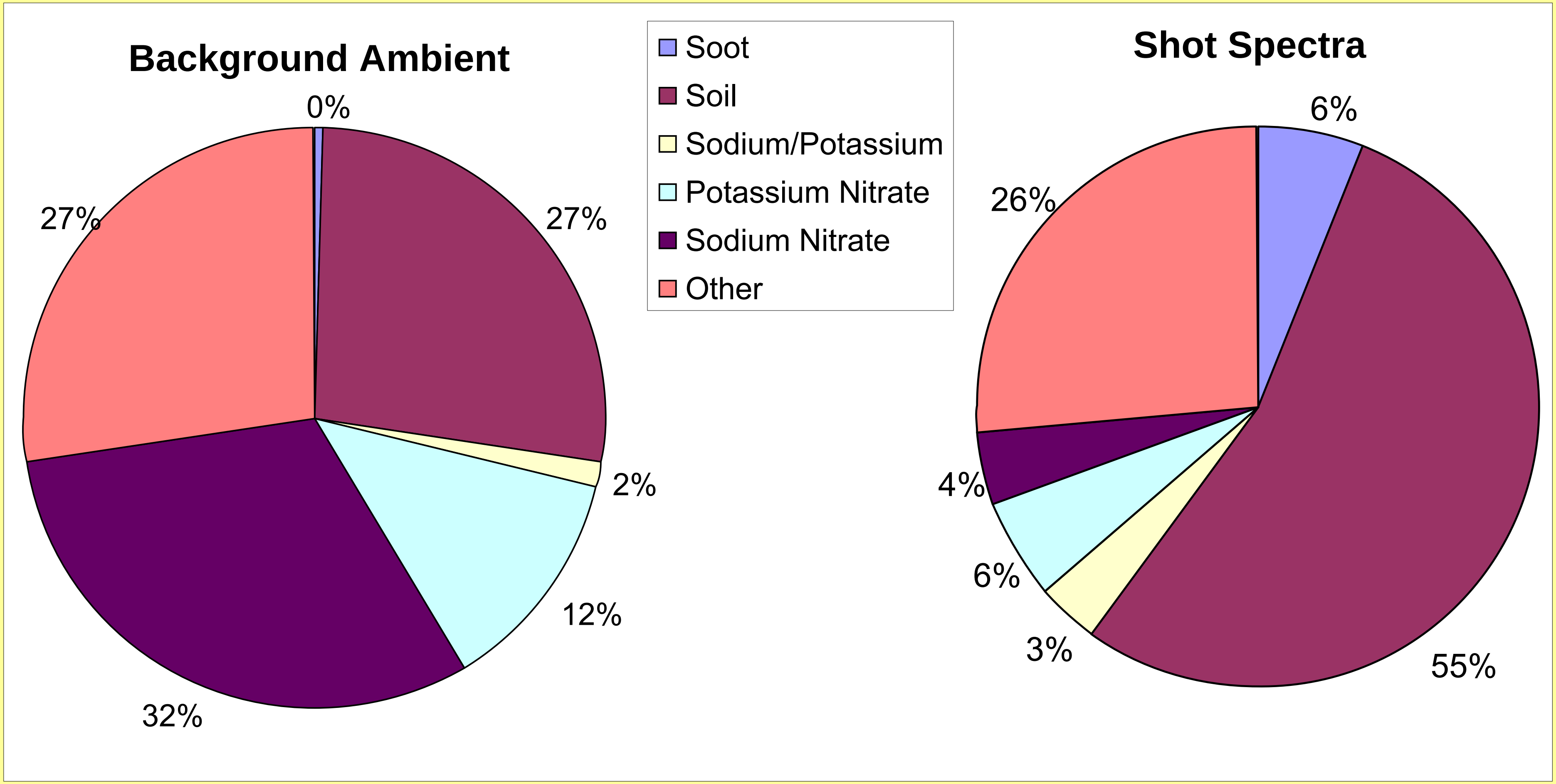
Other Background Particle Classes



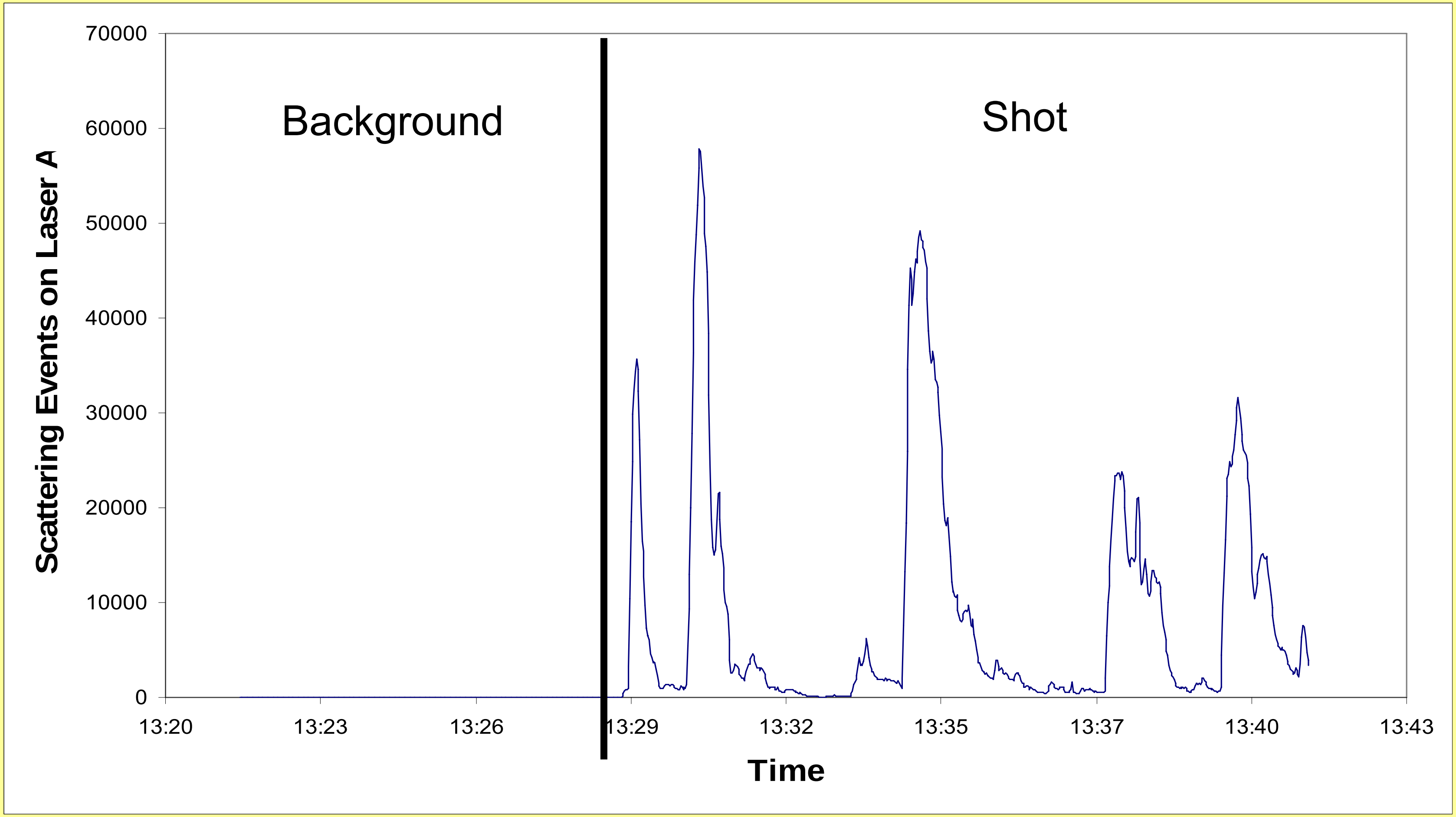
Silver Particle?



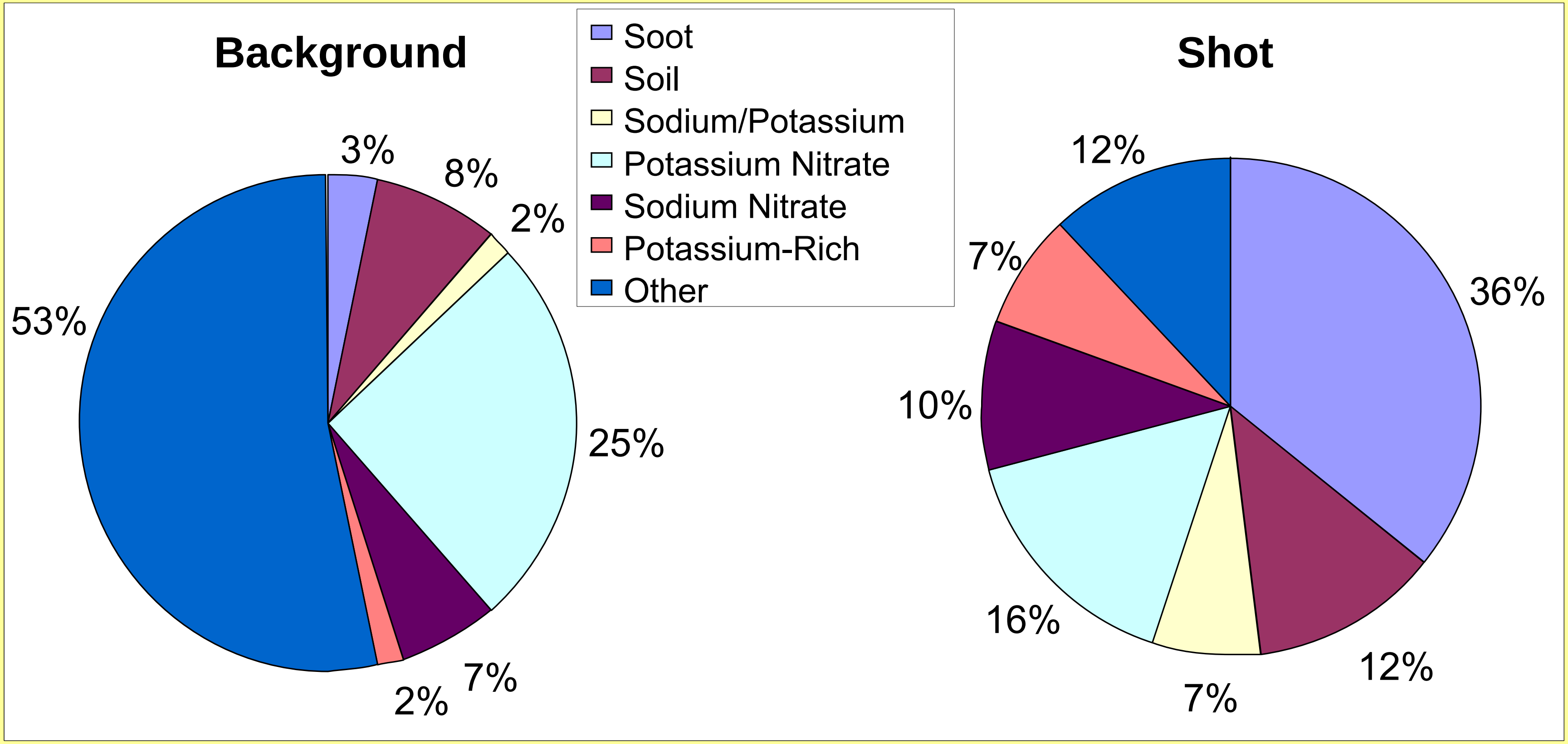
Near Shot Data: Before and After



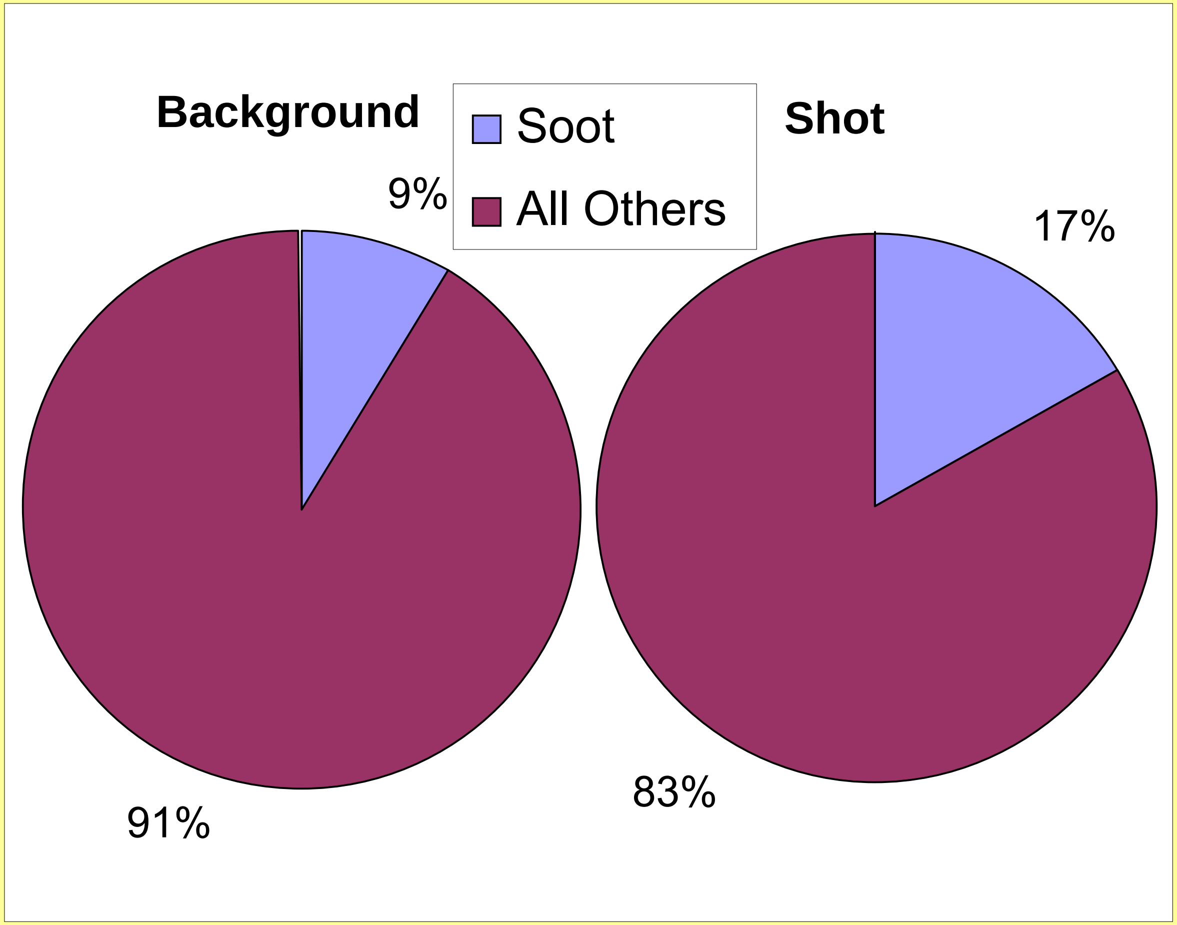
Midfield Plumes



200 Meters from shot

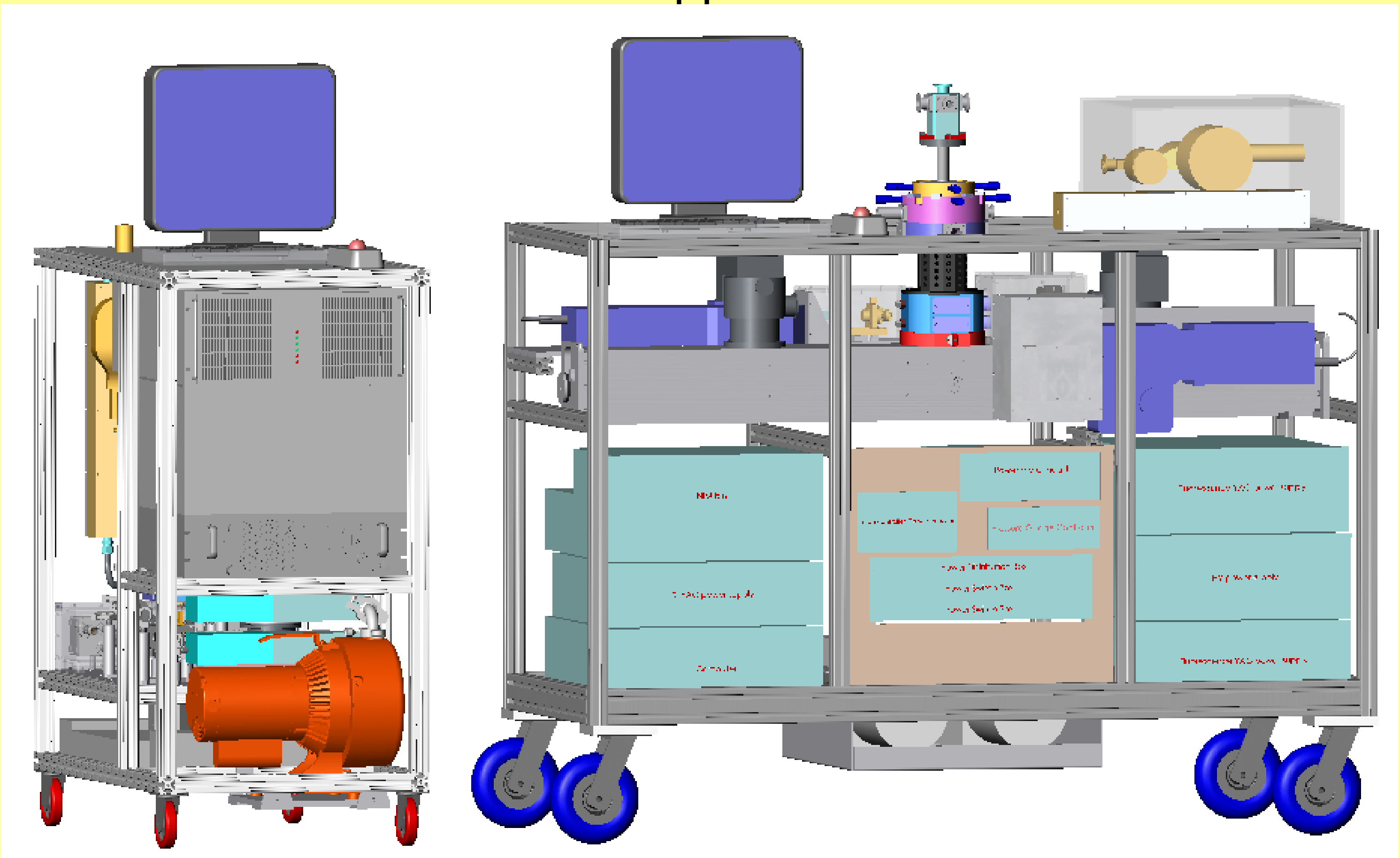


Particle Distributions at Fenceline



Conclusions/Future Research

- We can detect particles liberated from open detonation treatments at fencelines.
- Need to quantify particle concentrations.
- Need to test PAMS 2.0 for this application.



Acknowledgements

- The BAMS Group at LLNL
- Tooele Army Depot
  - Dave Ayala
  - Keith Siniscalchi
  - Spencer Chamberlain
- The funding agencies:
  - DoD Office Of Munitions TCG-IX
  - DARPA
  - TSWG
  - LLNL LDRD
  - DHS

This work was performed under the auspices of the U. S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.

Photo-Catalytic Degradation of Organic Molecules Using Free-Base Porphyrins

- T.C. Collins, D.F. Scofield, H.J. Harmon,
- T.M. Wilson, R. Rahman, C.B. Conner,
- R.C. Scott, S. Kwak

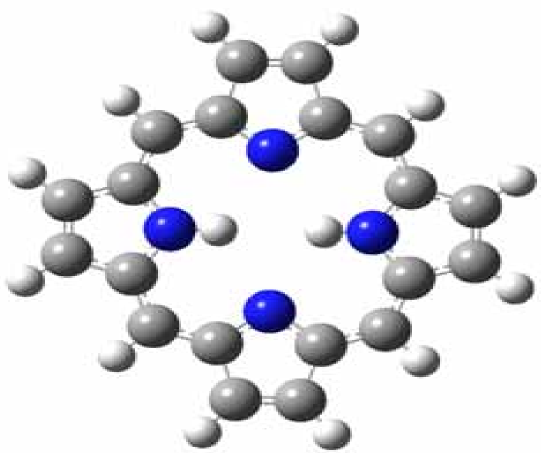
- Dept Physics, Oklahoma State University
  USAD Center, McAlester, OK

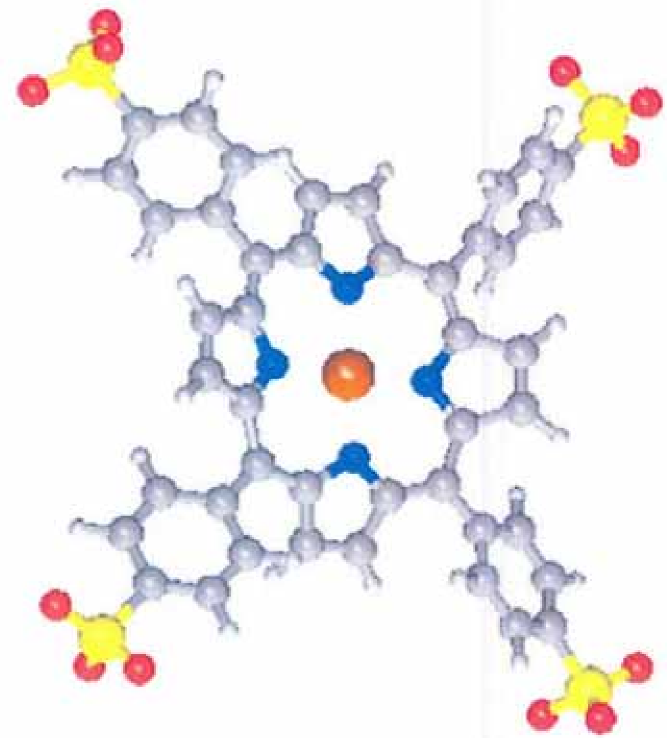
Defense Ammunition Center
McAlester, Oklahoma

Aqueous Photo-Catalysis

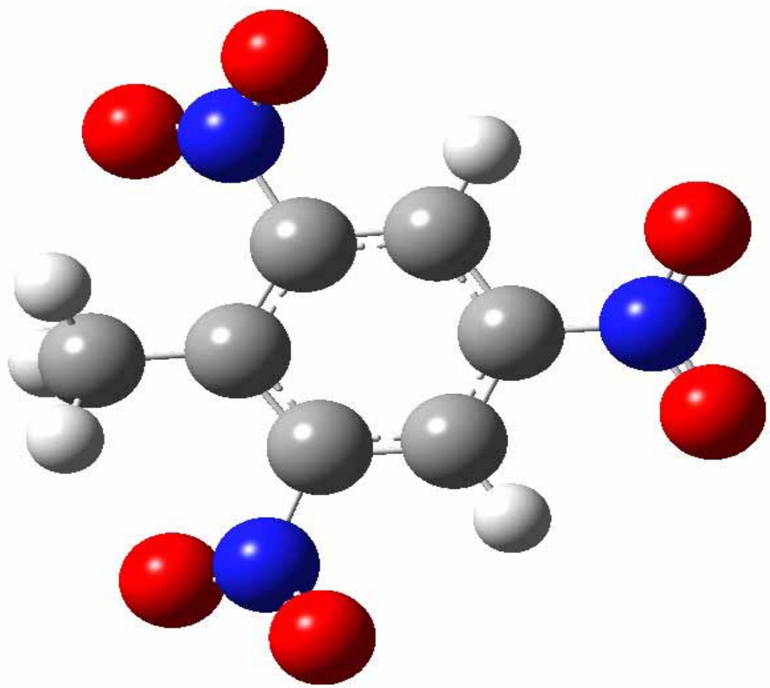
- Heterogeneous using FePor
- Homogeneous using
- Iron Porphyrin
- Free-Base Porphyrin

Free-Base Porphyrins

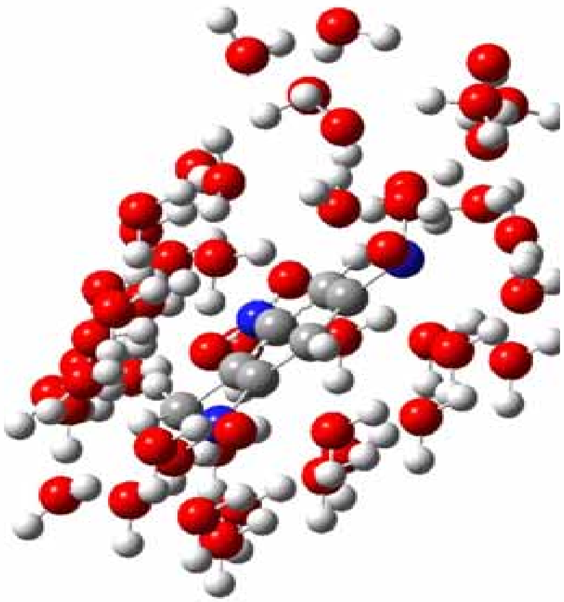


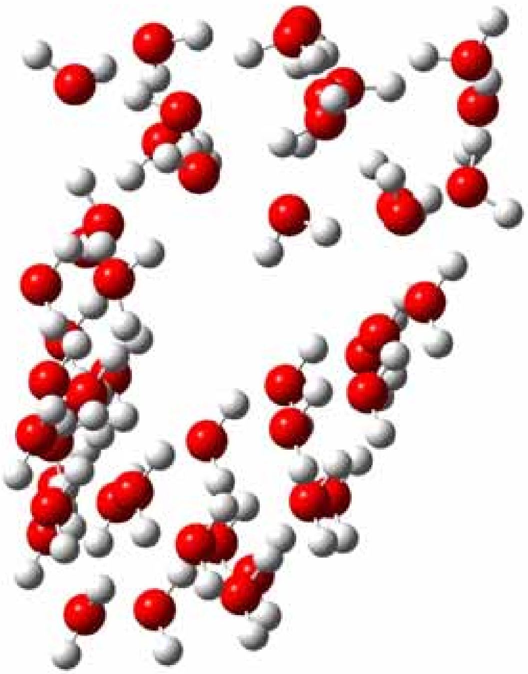


Target Molecule

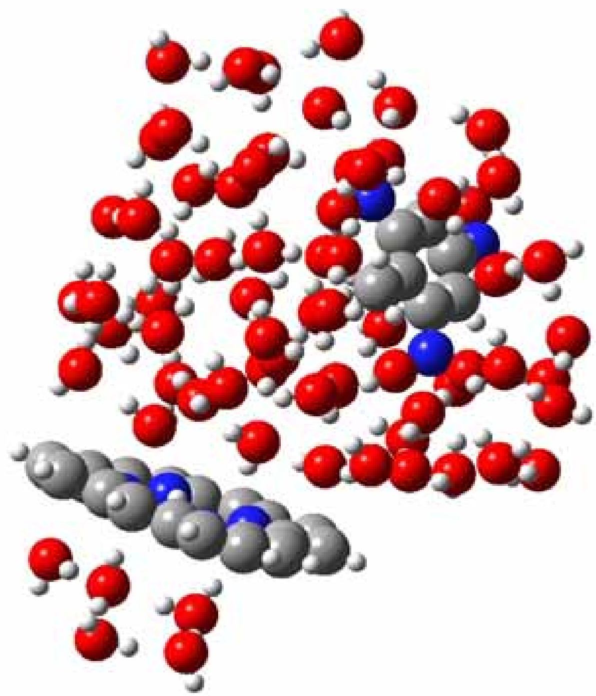


Solvation Shell

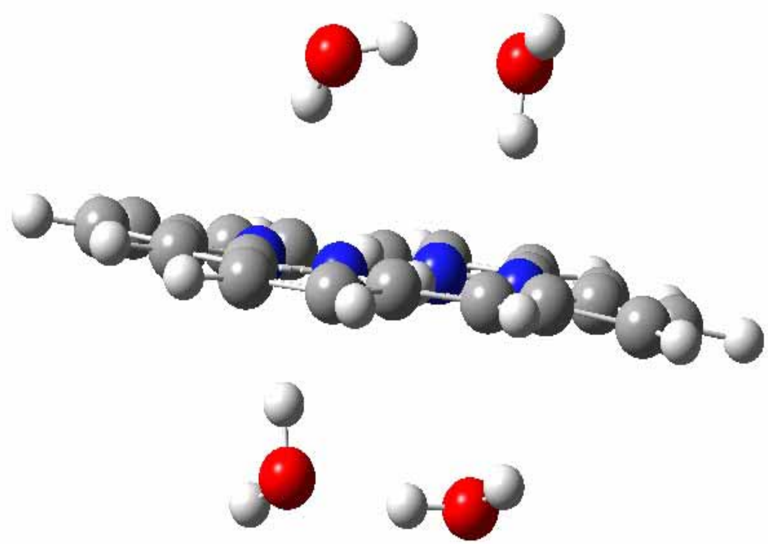




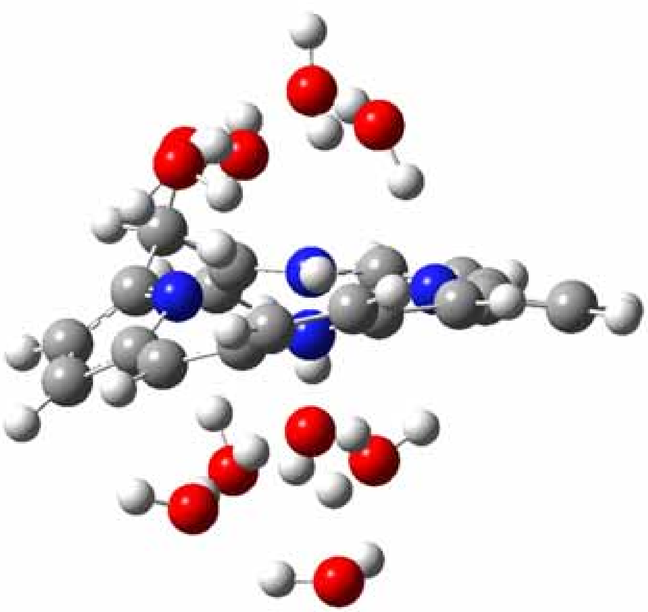
Docking Catalyst to Target in Water

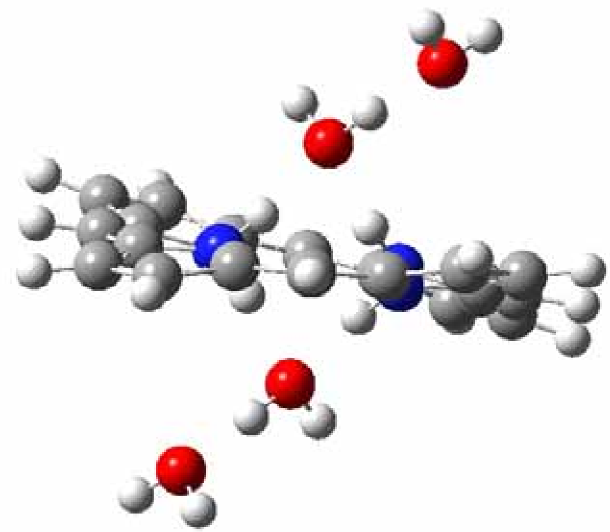


Absorption / Structure
Free-Base Porphyrin

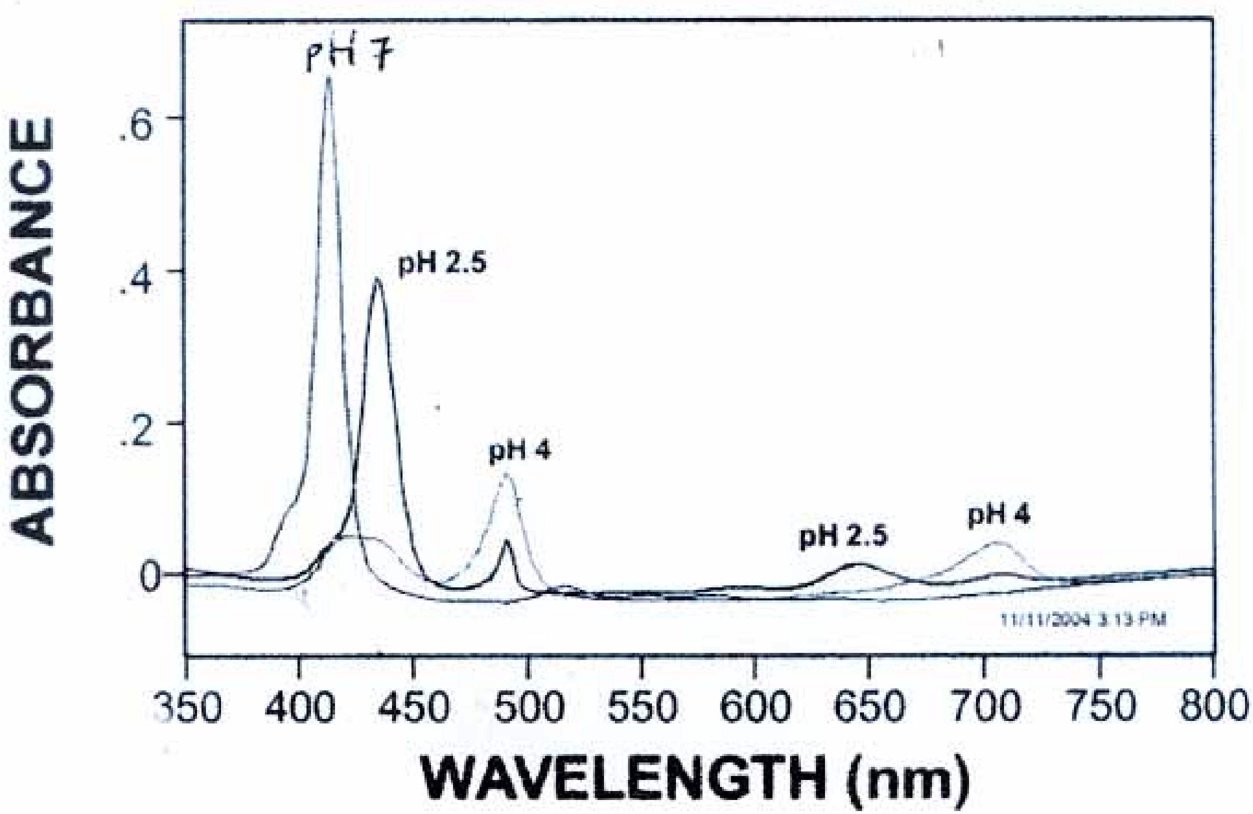


Absorption / Structure Protonated Porphyrin



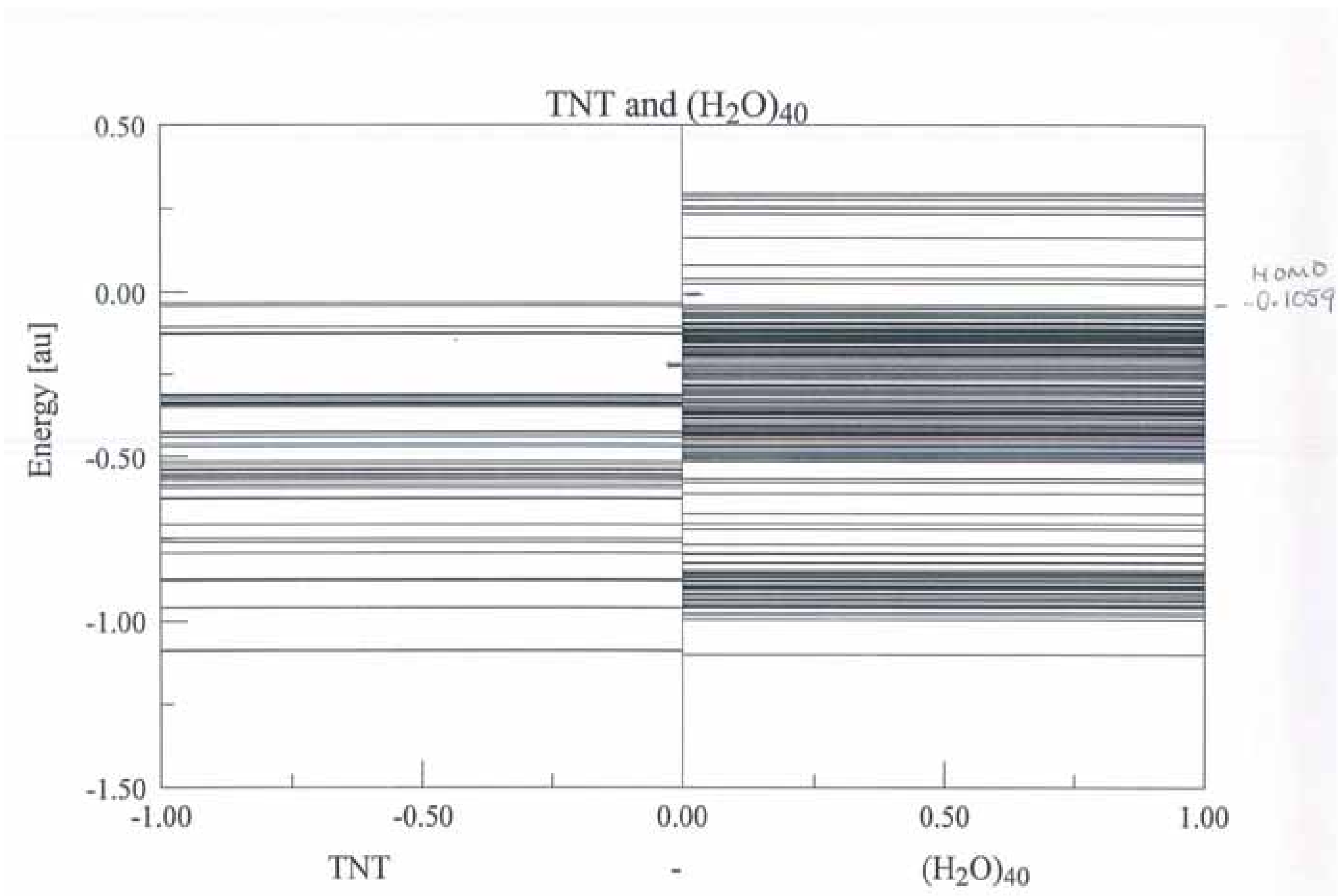


Absorption Dependence on pH

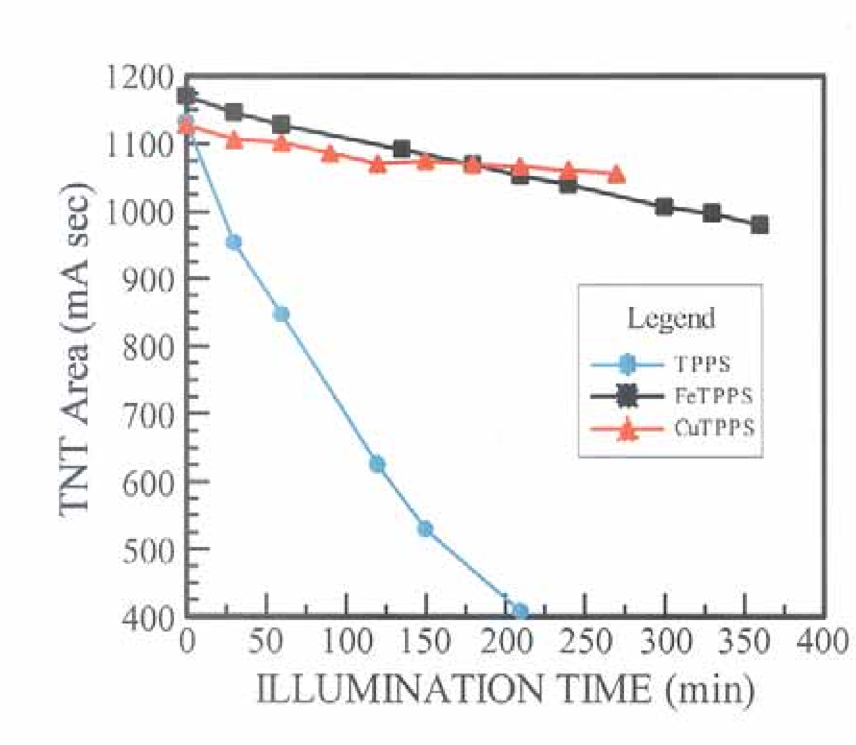


$$
\begin{gathered}
\mathrm{H_2Por} + \mathrm{H_2O} + h\nu \longrightarrow \mathrm{PorH_2^+} \cdot \mathrm{O^-} + \mathrm{H_2}, \\
\mathrm{H_2^+Por} \cdot \mathrm{O^-} + \boxed{\text{R-CH}_3} \longrightarrow \mathrm{H_2Por} + \boxed{\text{R-(C=O)H}} + \mathrm{H_2}, \\
\mathrm{H_2^+Por} \cdot \mathrm{O^-} + \text{R-(C=O)H} \longrightarrow \mathrm{H_2Por} + \text{R-(C=O)OH}, \\
\mathrm{H_2Por} + \mathrm{H_2O} + h\nu \longrightarrow \mathrm{H_2Por} \cdot \mathrm{H^+} + \mathrm{OH^-} \qquad \text{[n.b. pH dependent]}, \\
\mathrm{H_3Por} + \mathrm{H_2O} + h\nu \longrightarrow \mathrm{H_3Por} \cdot \mathrm{H^+} + \mathrm{OH^-} \qquad \text{[n.b. pH dependent]}, \\
\mathrm{H_2Por} \cdot \mathrm{H^+} + \mathrm{OH^-} + \text{R-(C=O)OH} \longrightarrow \mathrm{H_2Por} + \boxed{\text{R-H}} + \mathrm{CO_2} + \mathrm{H_2O}, \\
\mathrm{H_3Por} \cdot \mathrm{H^+} + \mathrm{OH^-} + \text{R-(C=O)OH} \longrightarrow \mathrm{H_3Por} + \text{R-H} + \mathrm{CO_2} + \mathrm{H_2O}, \\
\text{R-(C=O)OH} \xrightarrow{\mathrm{H_2Por}} \text{R-H} + \mathrm{CO_2}.
\end{gathered}
$$

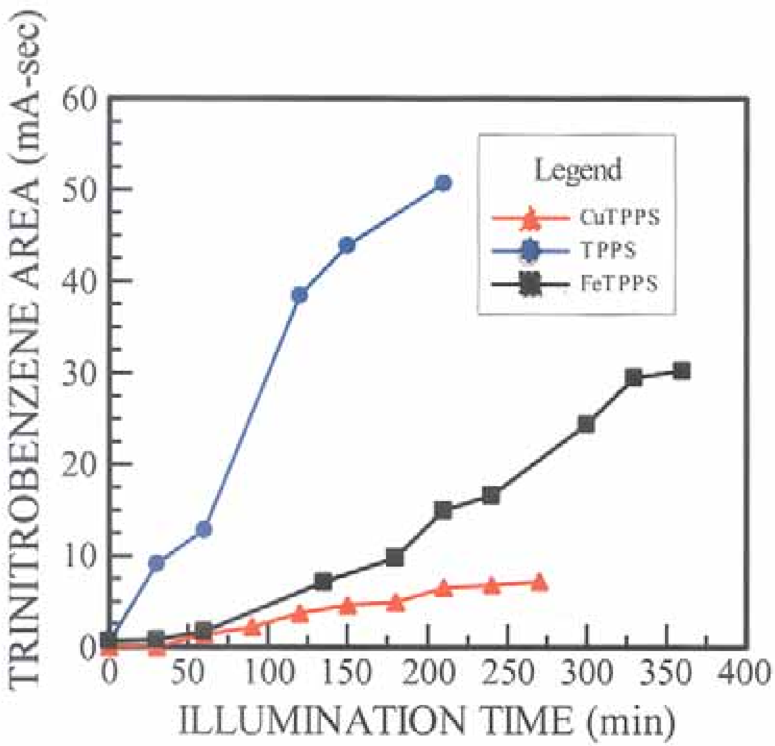
Donor /Acceptor

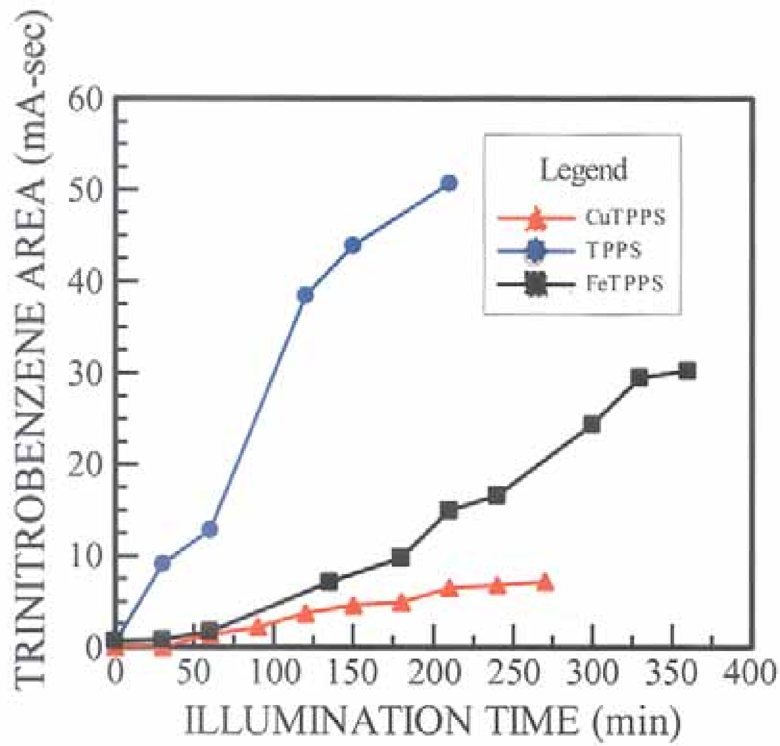


Reaction Yields Remediation of TNT



Production of TNBA and TNB





Conclusions

Optical absorption depends on:

Water cage

Creation of protonated species

TNB and TNBA produced by catalytic cycle involving these species

PHOTOCATALYTIC DESTRUCTION OF TNT

H. James Harmon
Department of Physics
Oklahoma State University

Solim Kwak
Defense Ammunition Center
McAlester, OK

What is the advantage of photocatalysis?

- We use a solid-state catalyst that is not consumed in the reaction. We do not need to add chemicals, acids, etc for the reaction. We are water-based.
- Photocatalysis is currently performed at normal ambient temperatures and normal pressures.
- The energy source is sunlight (very inexpensive) or artificial lights and does not require UV lamps, etc.
- Electricity is needed only for pumps, sensors, orientation to the sun unless artificial light is needed.
- Photocatalysis can be done as an on-line process, not a “batch” process.

COMPONENTS OF THE OSU-DAC REACTOR

- SOLID-PHASE PHOTOCATALYST IN A TRANSPARENT HOUSING; optimize surface area.

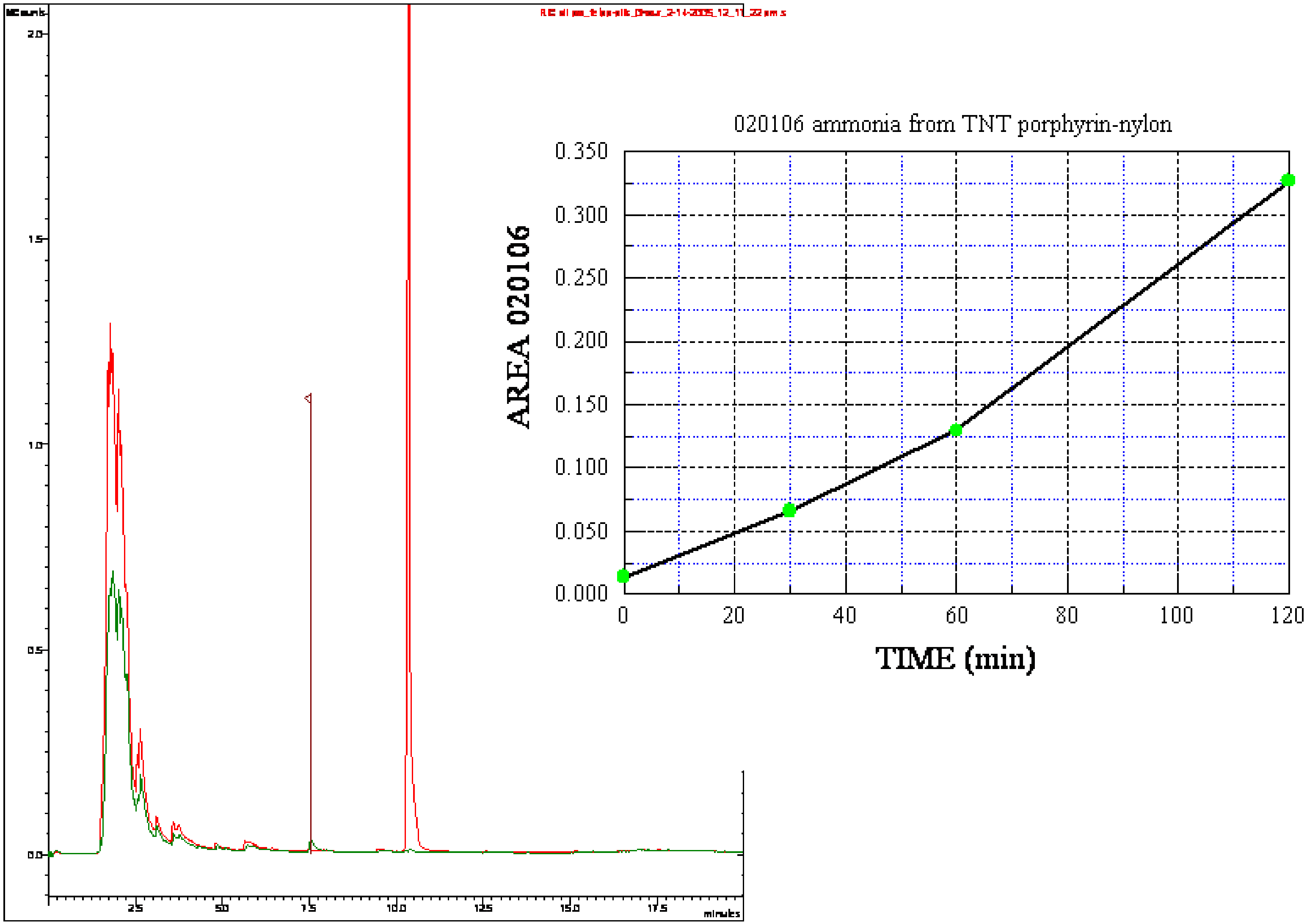
- SOLAR TRACKING PLATFORM to keep the panels oriented to the sun during the day for optimum illumination.

- PUMP to move the material to be treated.

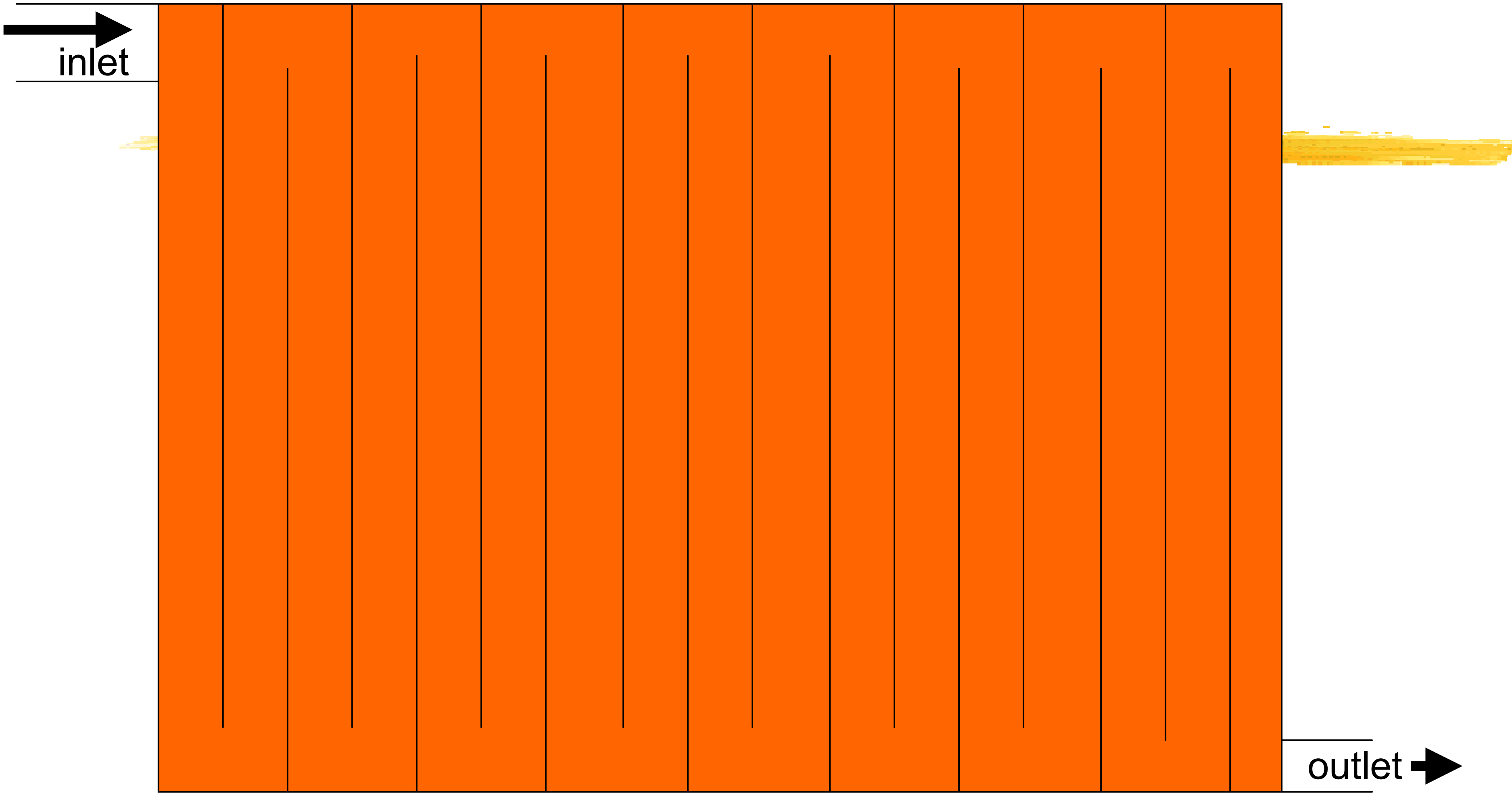
POWER can be provided by batteries or small gas-powered power plant/generator.

Overlaid Chromatogram Plots

Plot 1: d:\...pm_fetpp-plb_0hour_2-14-2005_12_17_22 p RIC all
Plot 2: d:\pm_fetpp-plb_1hour_2-14-2005_1_22_46 pm.sms RIC all

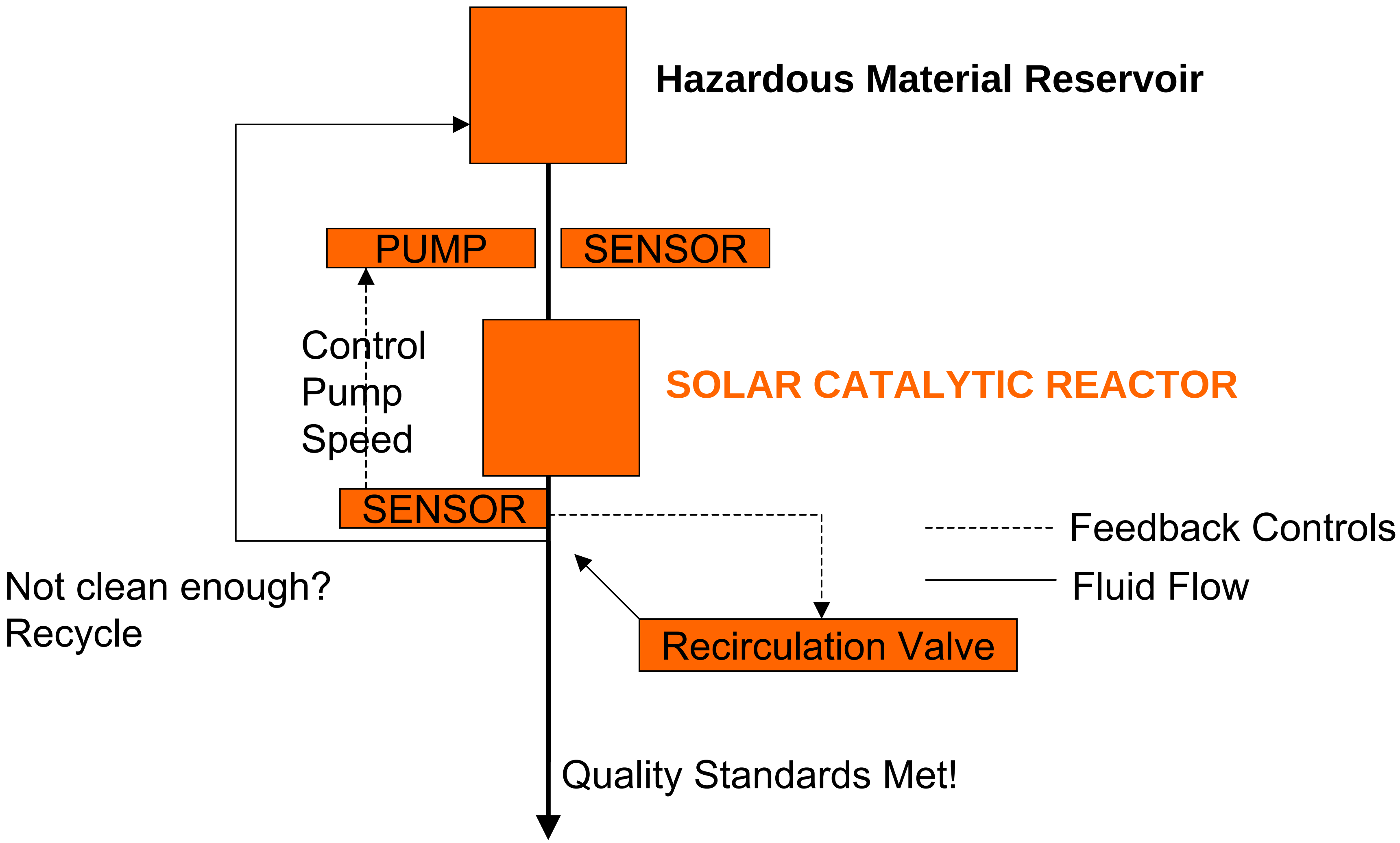


SCHEMATIC DIAGRAM OF THE SOLAR REACTOR PANEL

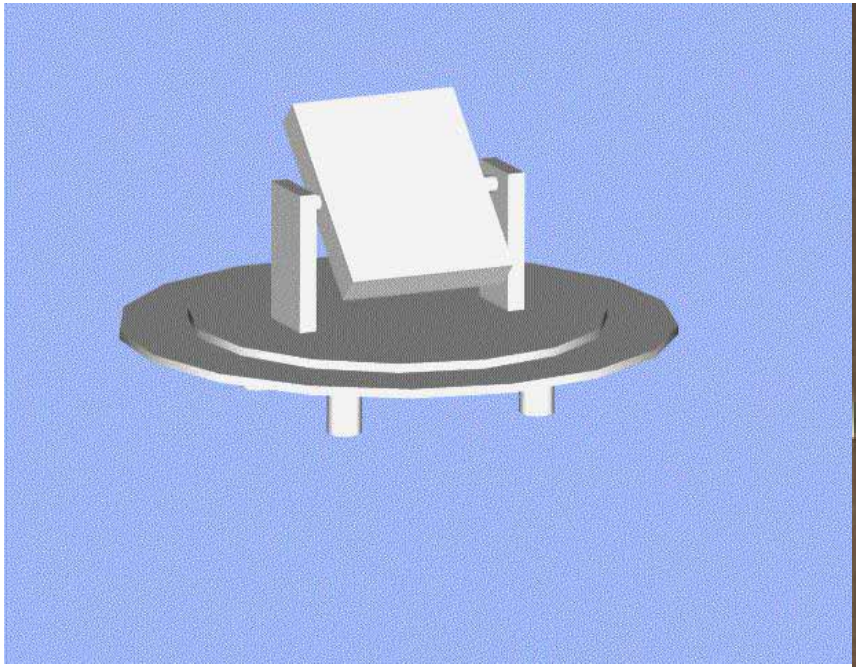


The overall size will be determined from mass and strength of the reactor panel.

PROCESS DIAGRAM



EFFLUENT for Further treatment or discharge



Go visit the prototype at the exhibits!.

HOW MUCH MATERIAL CAN BE HANDLED?

A 10 X 30 ft array of solar reactors will handle about 3,000 gallons of pink water every 12 hrs in full sunlight.

Artificial light is only slightly less effective.

The reaction even occurs on an overcast day, albeit slower.

COST OF THE CATALYST?

A 10 x 30 ft reactor would have less than

$8,000

of catalyst to treat 15,000 gallons
per 12 hours of sunlight
(OVER 5 MILLION GALLONS A YEAR)!
(Catalyst is re-useable but not indestructible)

LETS LOOK AT A REACTOR PANEL

- SIZE: 1.2 X 1.2m
- 80 1.2m tubes with 1 cm ID
- 160 polyethylene connectors
- 6.28 grams of catalyst per tube
- ~1.41 m^2 per tube
- Total surface area per panel: ~112.7 m^2
- Volume of the panel: 6.3 liter
- Total weight of a panel with liquid: 29.5 lbs.

What else can be destroyed?

- Benzene and related molecules
- Formaldehyde
- Nitro-energetics
- Dioxane-based molecules
- Chemical warfare agents and their breakdown products; these are very hard to breakdown normally.
- Pesticides
- The full range of susceptible compounds has not been fully explored!

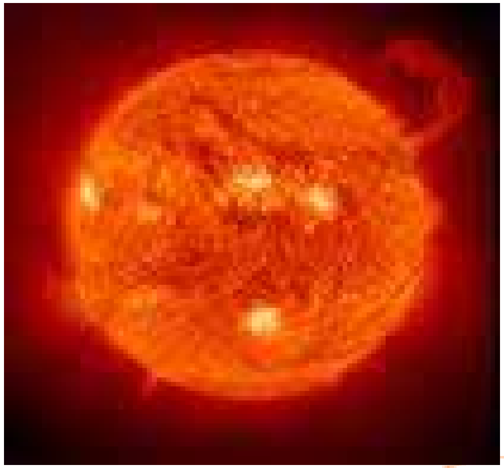
Key Aspects of this Technology

- Mechanical supports, motors, trackers
- Sensors for the analyte to be destroyed; this is not a "cookbook process"; it should be controlled and monitored for maximum efficiency.
- Catalyst
  - Coating the glass surface
  - Packing the glass tubes

COLLABORATORS

Defense Ammunition Center
McAlester, Oklahoma

Here comes the Sun!



CBEAR

Chemical, Biological, and

Energetic Agent Research

Structural Response, Munition Destruction Capabilities and Environmental Testing Results for a Large Controlled Detonation Chamber (CDC)

Presented at

14th Annual NDIA Global Demilitarization Conference
Indianapolis, Indiana
May, 2006

Presented by
Jay Quimby, Ph.D.
CH2M HILL, Inc.

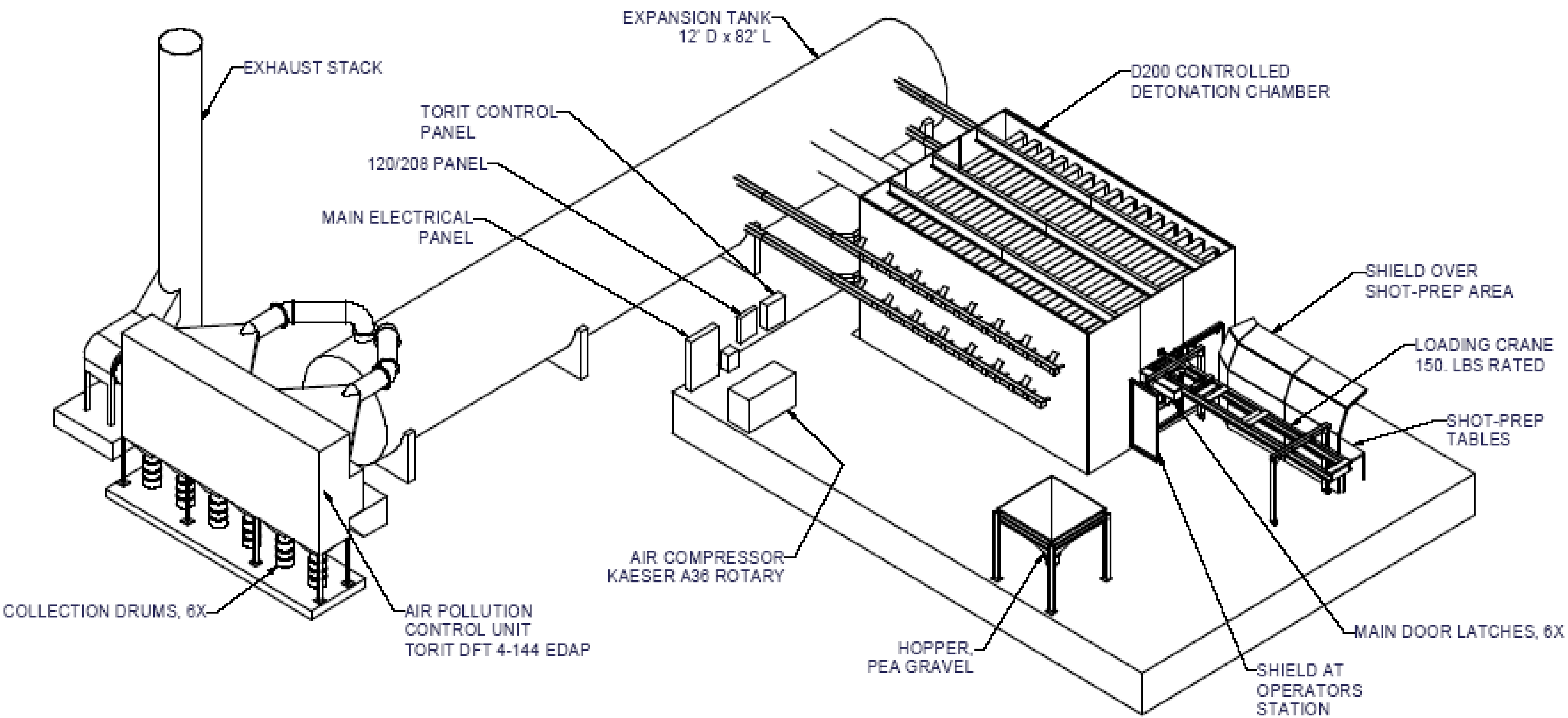
D-200 CDC System

- D-200 CDC Located at Crane Army Ammunition Activity within NSWC-Crane Division
- Purpose: To augment OB/OD operations during periods of bad weather or high noise propagation
- Built on-site at NSWC-Crane Division by CH2M HILL in 2002

D-200 CDC Installation at NSWC-Crane Division

CH2MHILL

D-200 CDC Layout



CH2MHILL

D-200 CDC System Details (1)

- Detonation Chamber
  - Contains blast overpressure and fragmentation
  - 16 ft wide x 14 ft high x 28 ft long (Volume = 6,272 ft^3)
  - Interior lined with AR-500 wear plate (fragmentation protection)
  - Passive ventilation via 72 – 7/8" orifices
- Expansion Tank
  - Allows detonation gases to expand, avoiding very high downstream pressures
  - 82-ft-long steel cylinder 12 ft diameter (volume = 9274 ft^3)
  - Operating Pressure <15 psig
- Air Pollution Control System
  - Donaldson Torit Unit (128 Cartridge Filters)
  - Process fan (35,000 scfm)

CH2MHILL

D-200 CDC System Details (2)

CH2MHILL

Overview of Testing Program

- Installation and testing of D-200 CDC as part of the Department of Defense, Joint Demilitarization Technology Demonstration Program
- CH2M HILL Demilitarization contracted by Crane Division, Naval Surface Warfare Center (NSWC Crane)
- System installed at Crane Army Ammunition Activity (2002)
- Testing conducted jointly by:
  - Crane Navy
  - Crane AAA
  - CH2M HILL Demilitarization with assistance from
    - ABS Consulting
    - AST Environmental
    - El Dorado Engineering
- Three phase test program
  - Phase I – Structural Response
  - Phase II –Environmental/Worker Exposure
  - Phase III - Operational Capabilities

CH2MHILL

Phase I- Structural Response

- Calibrated instruments and refined the data collection approach – strain (44), pressure (6), acceleration (3) and temperature (6), thermal flux(5) and external overpressure (4)
- Determined working NEW capacity
- Compared bulk explosive materials to determine in-system equivalency on the basis of the D-200's structural response
- Evaluated the system's operational envelope

Strain gage installation

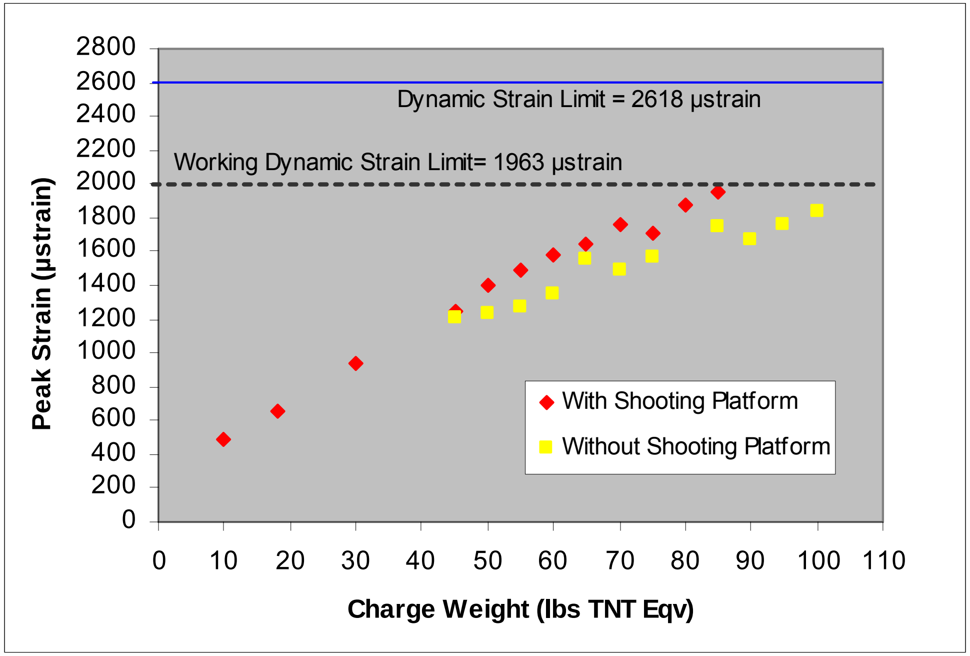
Over-pressure and Thermal Flux Gages

Primary Door Latches and Secondary Door

CH2MHILL

Phase I - Results

- Identified areas of highest strain as beam-to-beam corner connections (follows modeling predictions)
- Established NEW working limit at 100 lbs Comp B (based on 75% dynamic strain limit set by DDESB)
- Determined in-system TNT explosive equivalencies for C4, Comp B, Comp A-5 and PETN flexible sheet
- Upgraded detonation chamber door closures, installed secondary door for vapor control and installed Plexiglas shielding – complete containment of fragmentation, blast overpressure and thermal flux



Strain as a Function of Charge Weight

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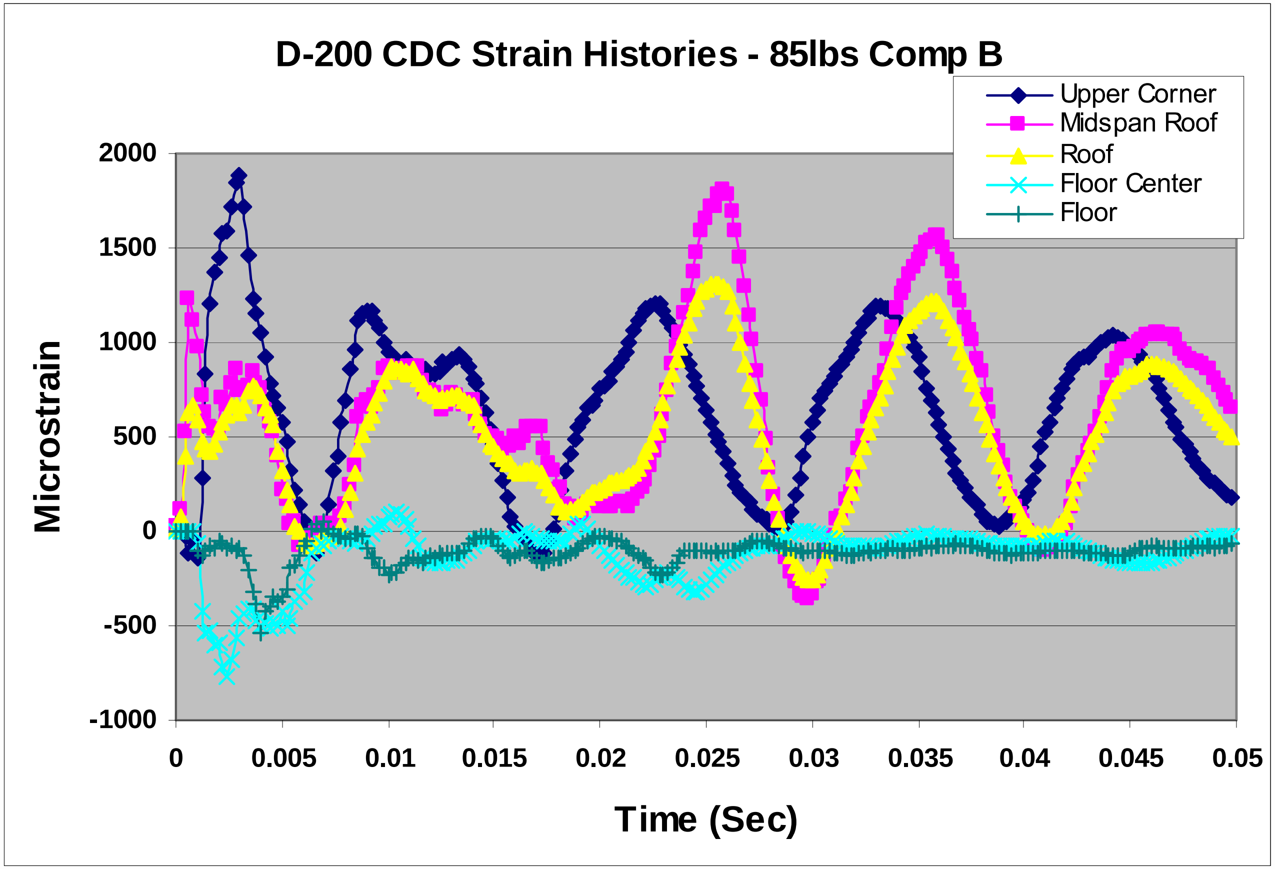
D-200 CDC - Typical Strain Response



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Phase II – Environmental Testing

- Collected integrated stack samples during three runs of 12 denotations of 5-in projectiles (over 3 hours)
- Air emissions analyses included - VOCs, SVOCs, metals, energetics, fix gases, PM
- Quantified worker exposures to dust, VOCs, Metals and Noise during operations
- Collected solid waste samples from detonation chamber, expansion tank and Torit filters. Analyses included - TCLP VOCs, SVOCs, metals and corrosivity

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Phase II – Results

- Stack gas emissions
  - Peak concentrations CO = 210 to 482 ppmv, NO_x = 60-104 ppmv, CO_2 = 1.64 - 1.92%, hydrogen <0.5 percent and methane < 0.1 percent
  - Identified VOCs were primarily C_2-C_6 olefins, benzene and toluene
  - Metals concentrations similar to background with slight elevation of aluminum
  - Energetic compounds were not detected in stack gas
  - PM10 average = 0.143 mg/dscm
- Worker exposures within applicable limits with the exception of impulse noise – hearing protection required
- Solid waste samples are not RCRA hazardous with exception of pea gravel (high pH)

D-200 CDC Stack Test Set-up

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Phase III – Capabilities Testing

- Destroyed a variety of munitions typical of items in the NSWC–Crane demilitarization inventory
- Evaluated effects of type and amount of donor explosives used and the resulting extent of destruction
- Evaluated effects of amount, arrangement, and ratio of water to net explosive weight used to configure the detonation

Phase III – Results

- Destroyed a variety of munitions in the NSWC–Crane demilitarization inventory
  - 3-in/50 cal cartridges
  - 105mm HE cartridges
  - 5-in HE projectiles
  - 155mm HE projectiles
  - 8in/55-cal fuzes
- Demonstrated multiple items per detonation: 2 x 5in/38cal, 2x155mm, 3 x 3in/50 cal
- Subjective evaluation of various donor explosives – Comp A5 showed best shattering effect
- Position and distance of water bags from target item had negligible effects on structural response or off-gas VOC composition -- Water not required for routine operations

Detonation of Triple 3-in/50 cal cartridges

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Other Recent CDC Experiences

- U.S. Army – Completion of Demonstration/Validation program for destruction of recovered chemical weapons (TC-60 CDC)
  - Destruction of various agent types: mustard, phosgene, chloropicrin, hexachloroethane/ zinc oxide (HC) smoke
  - Destruction of various fuzed munitions
  - Destruction of H contaminated bursters/fuzes from 4.2-inch UK mortars
  - Destruction of 101 recovered mustard-filled UK 25 pdr projectiles with no fugitive chemical agent emissions
- Belgium MOD - destroyed inventory of 2,500 recovered 77mm German WWI Clark-filled projectile (diphenyl chloroarsine)
- Camp Navajo - destroyed WP munitions including 57mm and 75mm projectiles and 81mm mortars
- Red Stone Army Ammunition Plant - destroyed:
  - CS grenades and 40mm cartridges
  - HC smoke grenades
  - Thermite (TH-3) grenades

UK 25 pdr projectile

Recovered WP Munitions

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D-200 Path Forward and Other CDC Projects

- D-200 CDC
  - Draft testing report currently under review
  - Preparation and submission of final ESS
  - Turn-over of D-200 system to Crane Army Ammunition Activity by end of FY 2006
- Other CDC Systems
  - DT/OT Phase for TC-60 CDC chemical system
  - Upgrades to increase BGAD D-100 CDC
  - Multiple munitions destruction projects with T-10 CDC (DoD and private sector)

Co-Authors:
Mr. Phillip Keith
NSWC-Crane Division
phillip.keith@navy.mil

Dr. Jay Quimby
CH2M HILL Demilitarization, Inc.
Jay.Quimby@ch2m.com

Explosive D Facility
Path from R & D to Execution

Ryan M Smith

Gradient Technology

Explosive D Facility Overview

- Facility developed to process Explosive D from varying stocks into Commercial Chemicals

Mechanical and Chemical Processing

Mechanical Processing

- Projectile Accessing System
  - JMC, PB/Nammo, CAAA, Gradient Technology

Chemical Processing

- Energetic Chemical Conversion System
  - DAC, NSWC-Crane Navy, Gradient Technology

Program History

- “Exp D” BAA Phase II awarded to GT in 1999
- GT’s first large scale program
  - Company Founded in 1996
- “D” Conversion IP developed by GT prior to contract
- R & D Phase, Engineering, and Equipment Fabrication took place at GT Corporate in MN
  - Lab Facilities, Engineering Office, Fabrication Facility

Keys to Early Program Success

- Full Corporate Commitment to the Program
  - Dedicated staff followed program from R & D Phase through to Installation, Commissioning, and Operations Phase
  - Program was always ranked as GT's top priority for allocating resources and funding

- Tremendous NSWC-Crane Support
  - Army and Navy divisions at Crane provided essential guidance from qualified personnel
  - Both organizations were exceptional as liaisons between GT and the other base activities involved in the program development

Original Capital Funding for Program

- Crane B105 Facility and Upgrades
  - CAAA (NSWC Tenant) and DAC
- Mechanical Processing Equipment
  - JMC via CAAA
- Chemical Processing Equipment
  - Gradient Technology

Challenges with Funding Arrangement

- Contractor Owned and Operated Equipment Located on a GOGO Facility
  - Equipment Limitations for installation in existing government Facility
  - Government responsibility of daily operations of Contractor owned and operated equipment

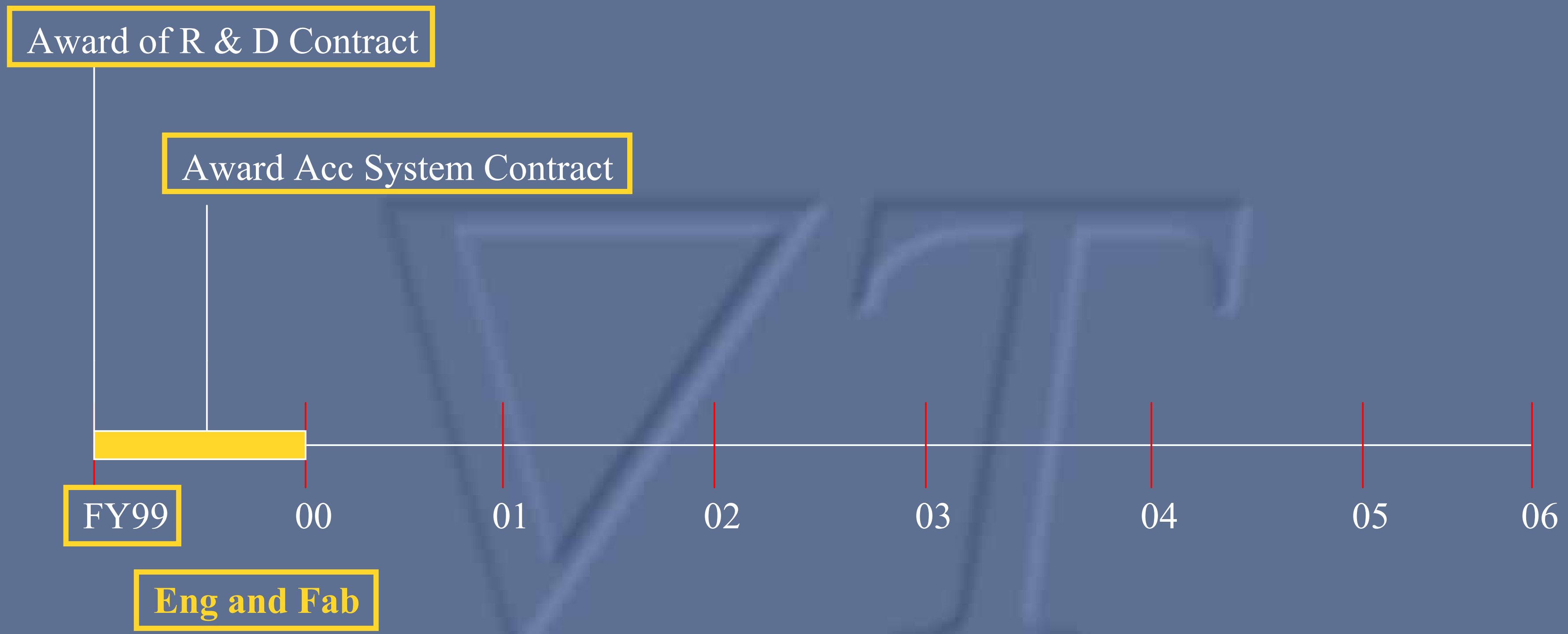
- Small Business and a Large Capital Investment
  - Difficulty in securing additional capital needs with the uncertainty surrounding long term workload

Establish Long Term Viability

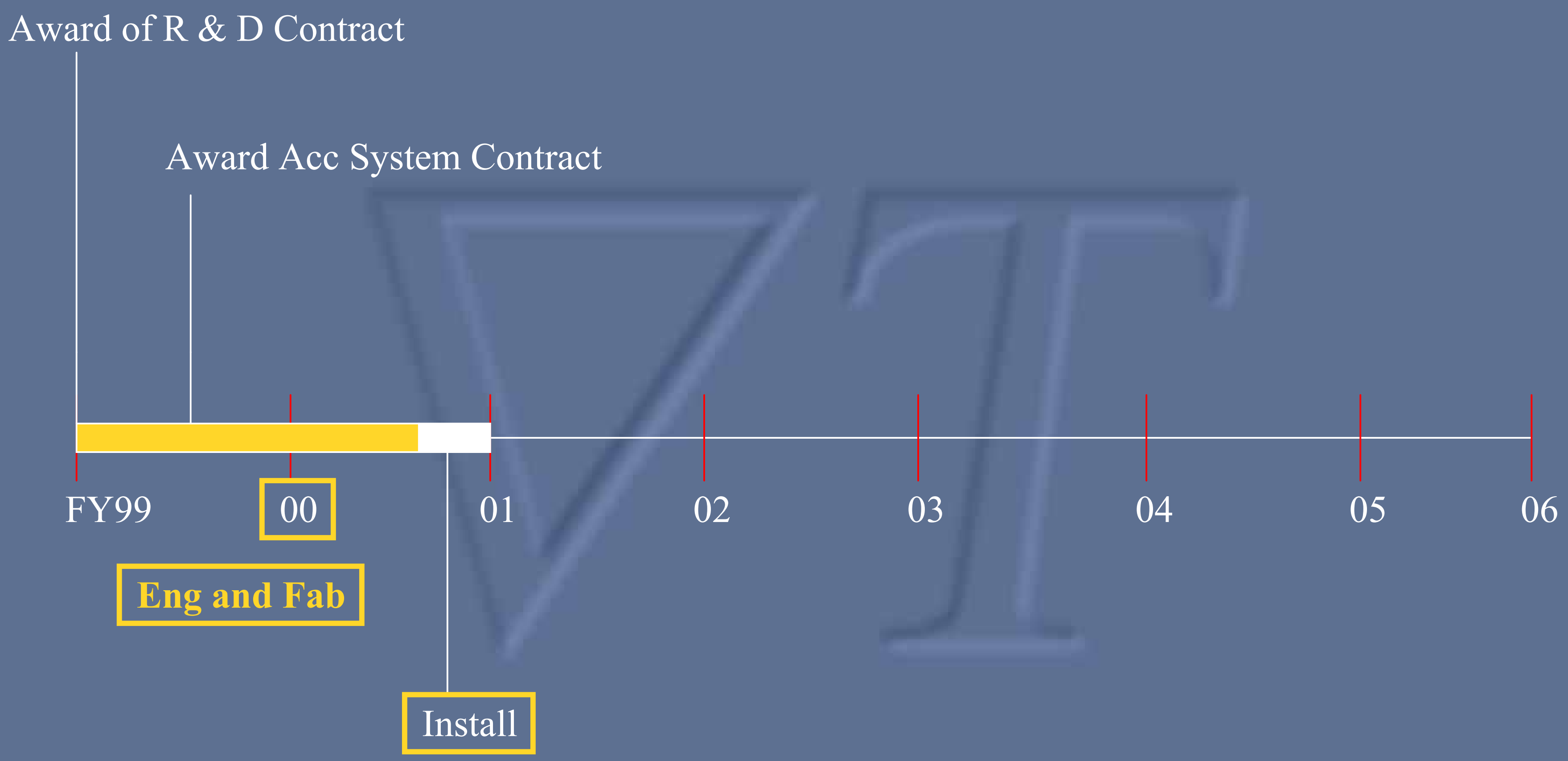
- Necessary Part of the R & D Process was to increase system capabilities when opportunities were present
  - Projectile Workload from Organic and Commercial
  - Major Capital Equipment Investments made based on the Projectile stocks (Gradient and JMC)
  - Essential Support from CAAA (Organic) and PB/Nammo (Commercial) workload to accomplish

- Effect of this opportunistic work and long range goals on the Chemical R & D process
  - Periods of less emphasis on Chemical R & D
  - But, lessons learned resulted in integral changes

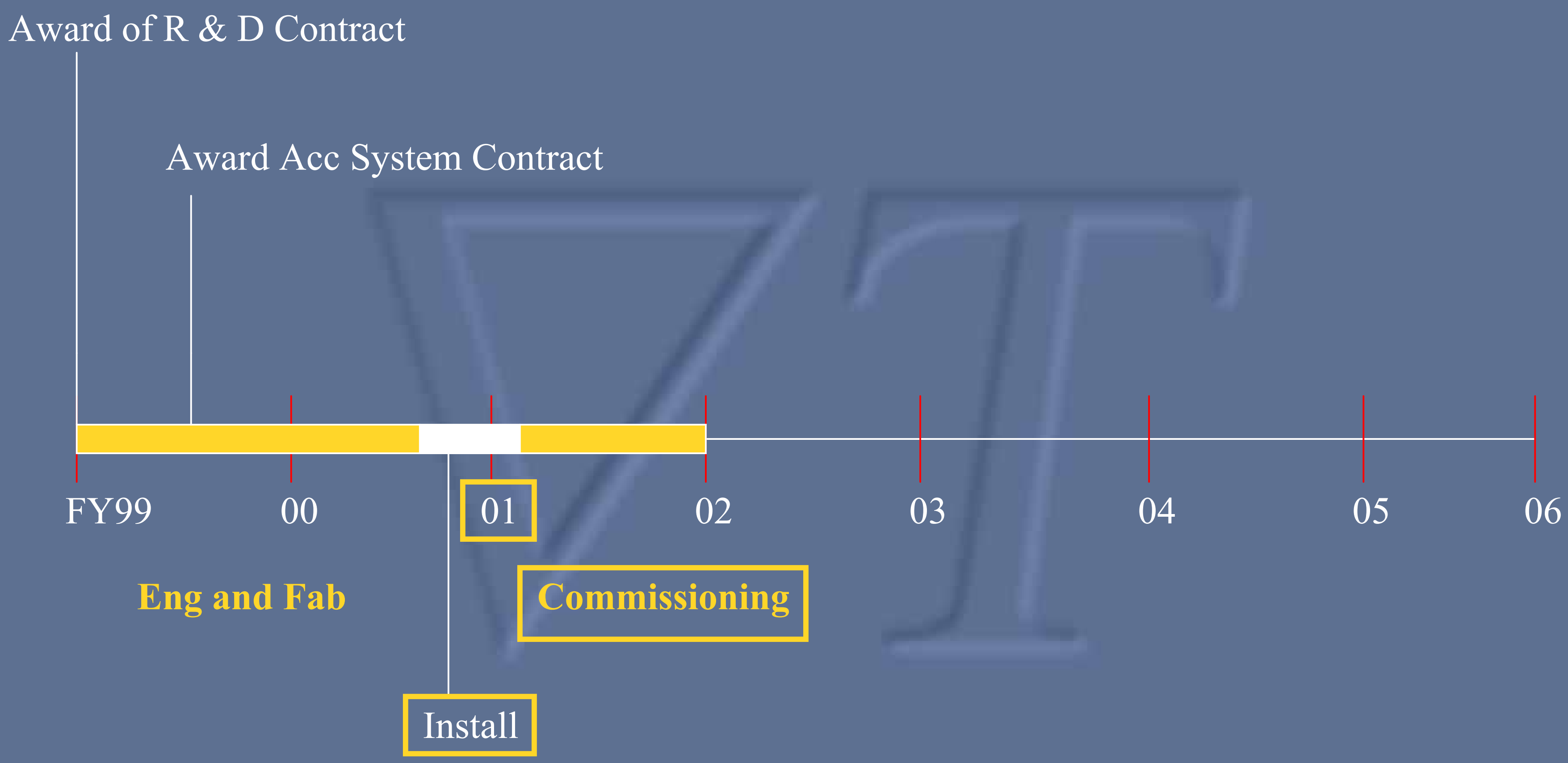
Operational Milestone Timeline



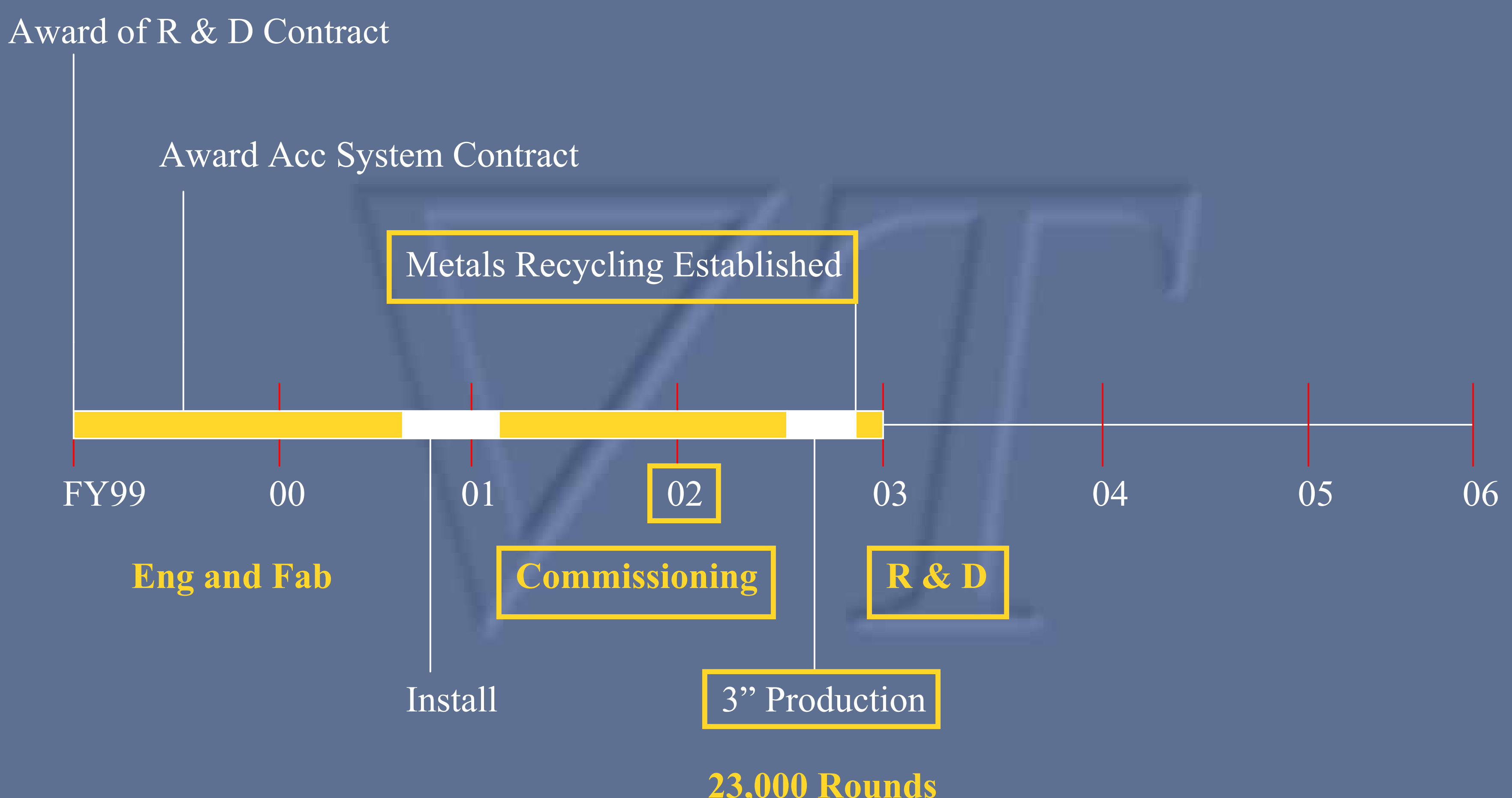
Operational Milestone Timeline



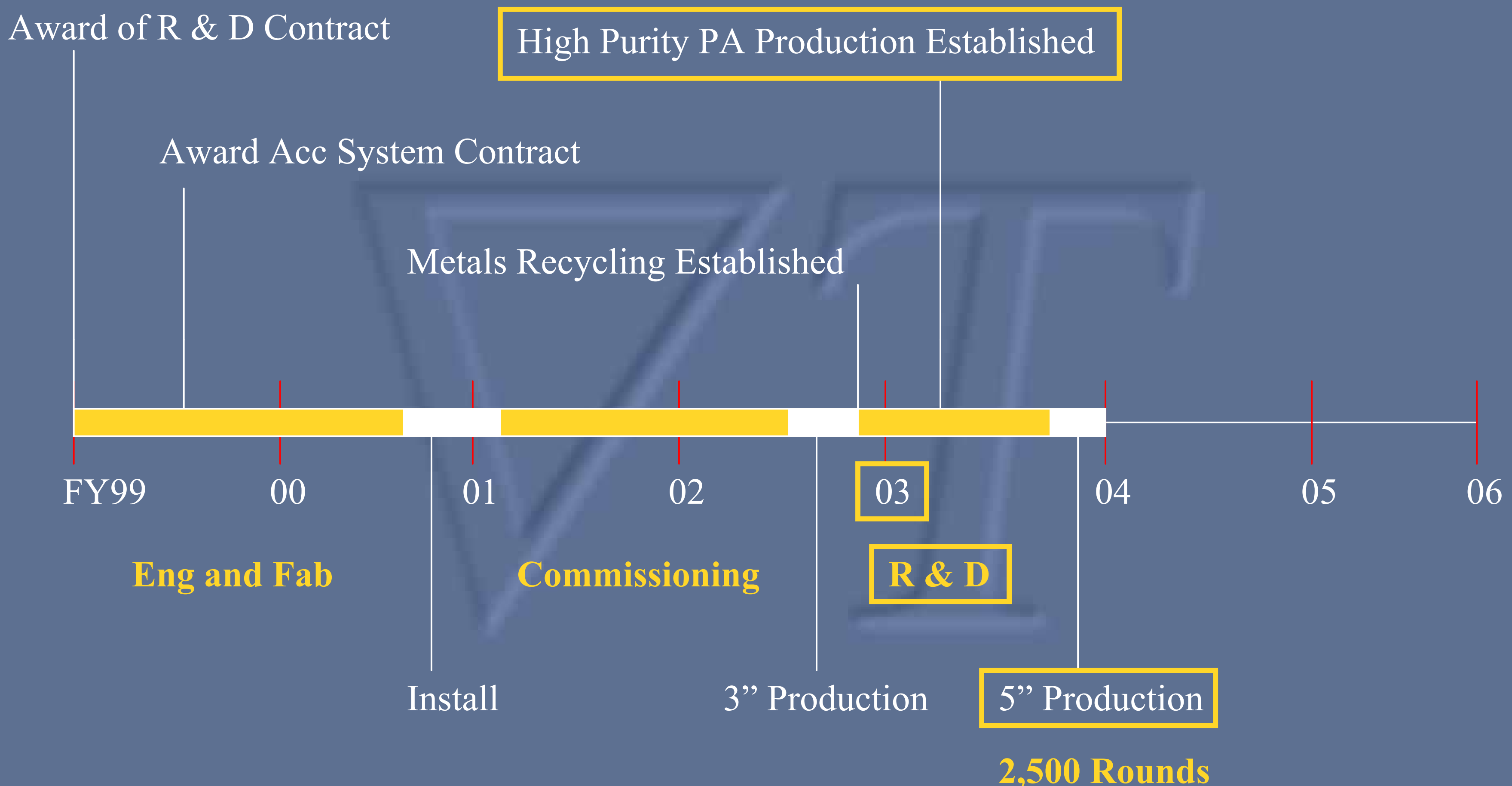
Operational Milestone Timeline



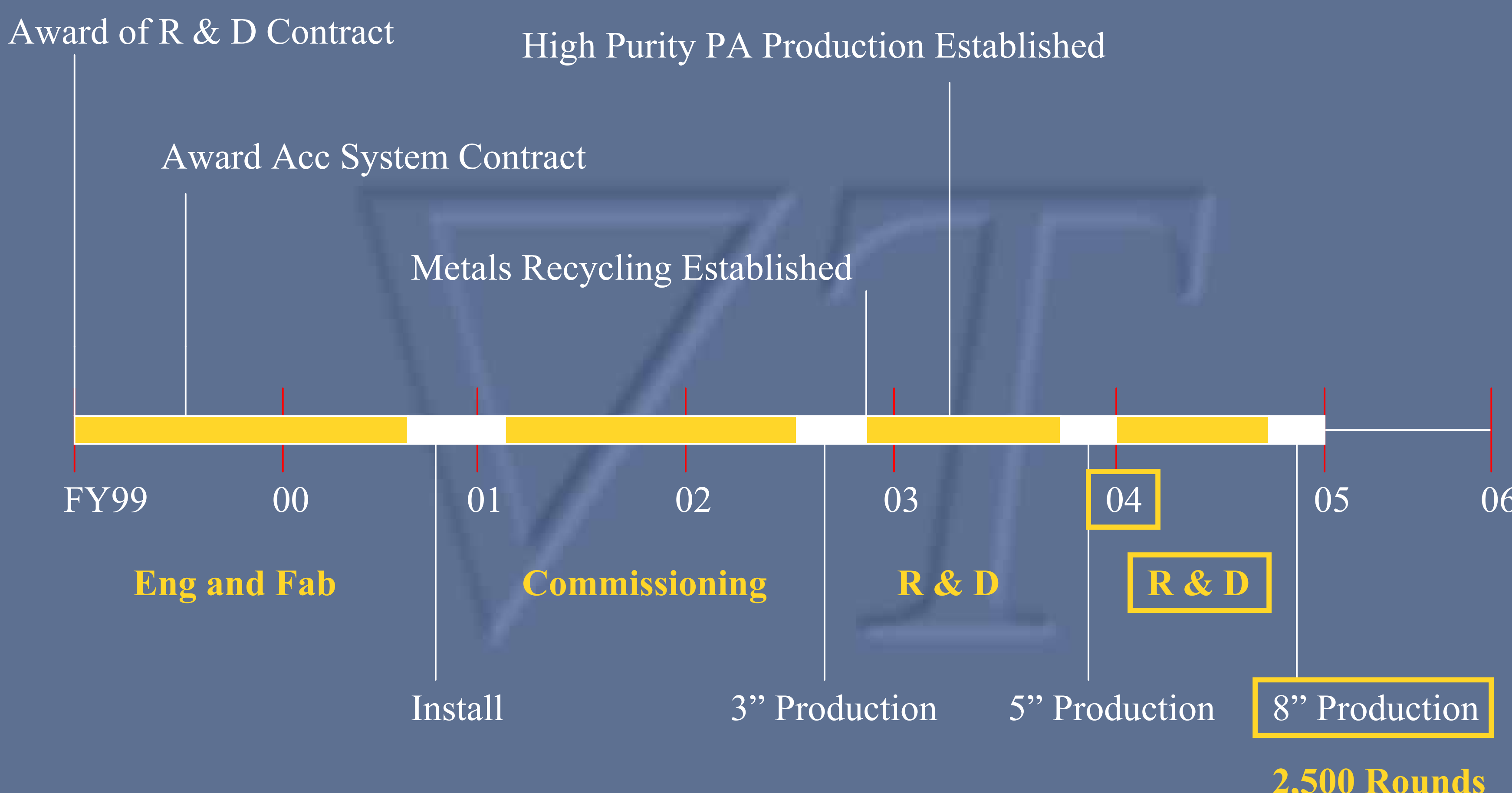
Operational Milestone Timeline



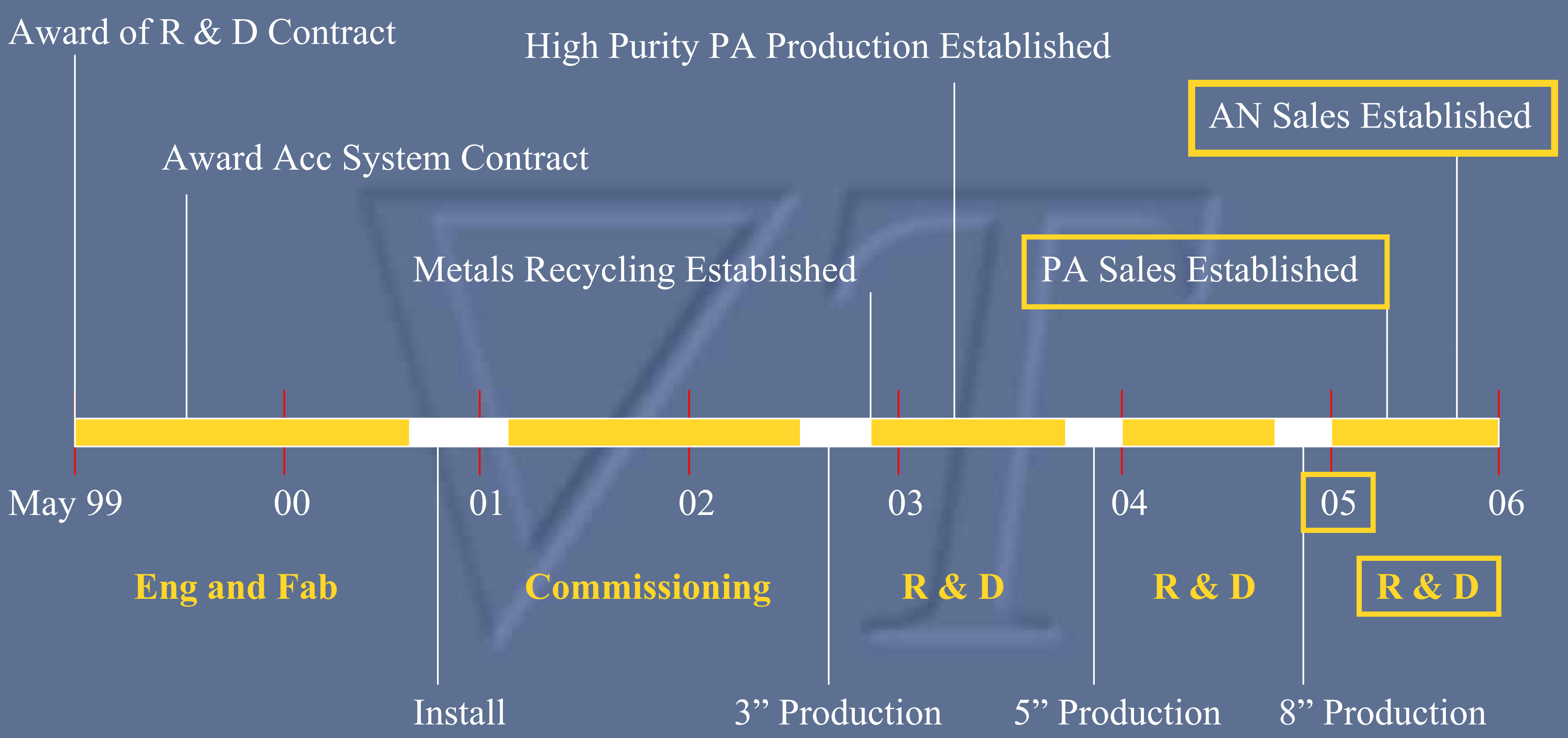
Operational Milestone Timeline



Operational Milestone Timeline



Operational Milestone Timeline



Transition from R & D to Execution

- Currently Planned Workload for Facility
  - Close out of the R & D Contract
  - Beginning of Commercial Demil Contract
  - Ongoing Support of the CAAA Organic Mission

Keys for Continuing Program Success

- Sustained commitment from Gradient
    - Dedicated to furthering Operational Improvements
    - Investments as needed in Processing Capabilities
    - Further improvement in Execution Costs

- Commitment from Execution Programs
    - Sufficient Workload to Justify Contractor Investments
        - Resources and Operations Personnel
        - Equipment Improvements
        - Intellectual Property

Special Thanks

DAC

JMC

CAAA

Demil Metals

NSWC-Crane Division

PB / NAMMO

Flashless Powder for Small Arms Ammunition
from Demil Artillery Propellant

Thane Morgan
Principal Investigator

Rick Snow
Program Manager

TPL, Inc. • 3921 Academy Parkway North, NE • Albuquerque, NM 87109

Acknowledgements

Program Support and Technical Guidance:

Dan Burch and Josh Geary: Ordnance Engineering Department, NSWC-Crane

Aaron Williams: Technology Directorate, U.S. Army Defense Ammunition Center

Funding Sponsors:

James Q. Wheeler: Director, Defense Ammunition Center

LTC Brian Raftery: Product Manager for Demilitarization

Why Small Arms Powder from Artillery Propellant?

Artillery Propellants provide desirable characteristics to be exploited in Small Arms Ammo

- Low Flash (Flashless) muzzle signature (nighttime)
- Low Smoke muzzle signature (daytime)

Provides enhanced combat effectiveness and soldier survivability in darkness and urban combat

Albuquerque PD SWAT Squad

Night Firing

Conventional Ammo
Standard Powder .45 ACP

TPL Ammo
TPL Flashless Powder .45 ACP

Technical Challenge

Retain the Desirable Characteristics from the Artillery Propellants and match Small Arms Ballistic Performance (muzzle velocity and chamber pressure)

Approach: Four variables

- Powder: Each powder type burns at a different rate
- Grain Size: Smaller grains burn faster
- Load Size: Loads amounts vary the pressure
- Surface Morphology: High surface area from cracks and crevasses accelerate burning

Potential Artillery Propellant Feed Stocks

Propellants available to TPL from Demil Programs

- M1
- M6
- M8
- M9
- **M30**
- M30A1
- M31
- M31A1

All contain various additives to manage some aspect of interior ballistic performance (temperature, flash, burn rates, ignition, etc.)

M30 works as 45 ACP and 40 S&W.

May burn too fast for rifle, but we are very close to a desired chamber pressure vs. muzzle velocity

Development of Flashless Powder

Stage I (1999-2001)

Focused on commercial applications

- No significant price savings, no need for alternative powders.

Stage II (2001-Current)

Focused on law enforcement and Military Applications

- Police and SWAT interest, as night usage is common and critical. 45 ACP is a common police caliber
- SOF commonly use 45 ACP side arms, and are more flexible when purchasing ammunition
- Great interest in developing 5.56mm ammunition for M4/M16

Q30 in 45 Automatic

Nighttime SWAT Results with TPL's Powder

- 14 Shooters from Albuquerque's SWAT force
- Target Sight picture more readily acquired/reacquired
  - 30.0% faster second shot average second shot
  - 37.9% faster six-shots-on-target average
- Multi-shot firing times improved for <u>every</u> shooter
- Muzzle flash not visible from 50 ft

Nighttime Sensors Results with TPL's Powder

Much less visual signature

No disruption of NOD/NVD equipment

NSWC Powder Evaluation

Ballistic performance match

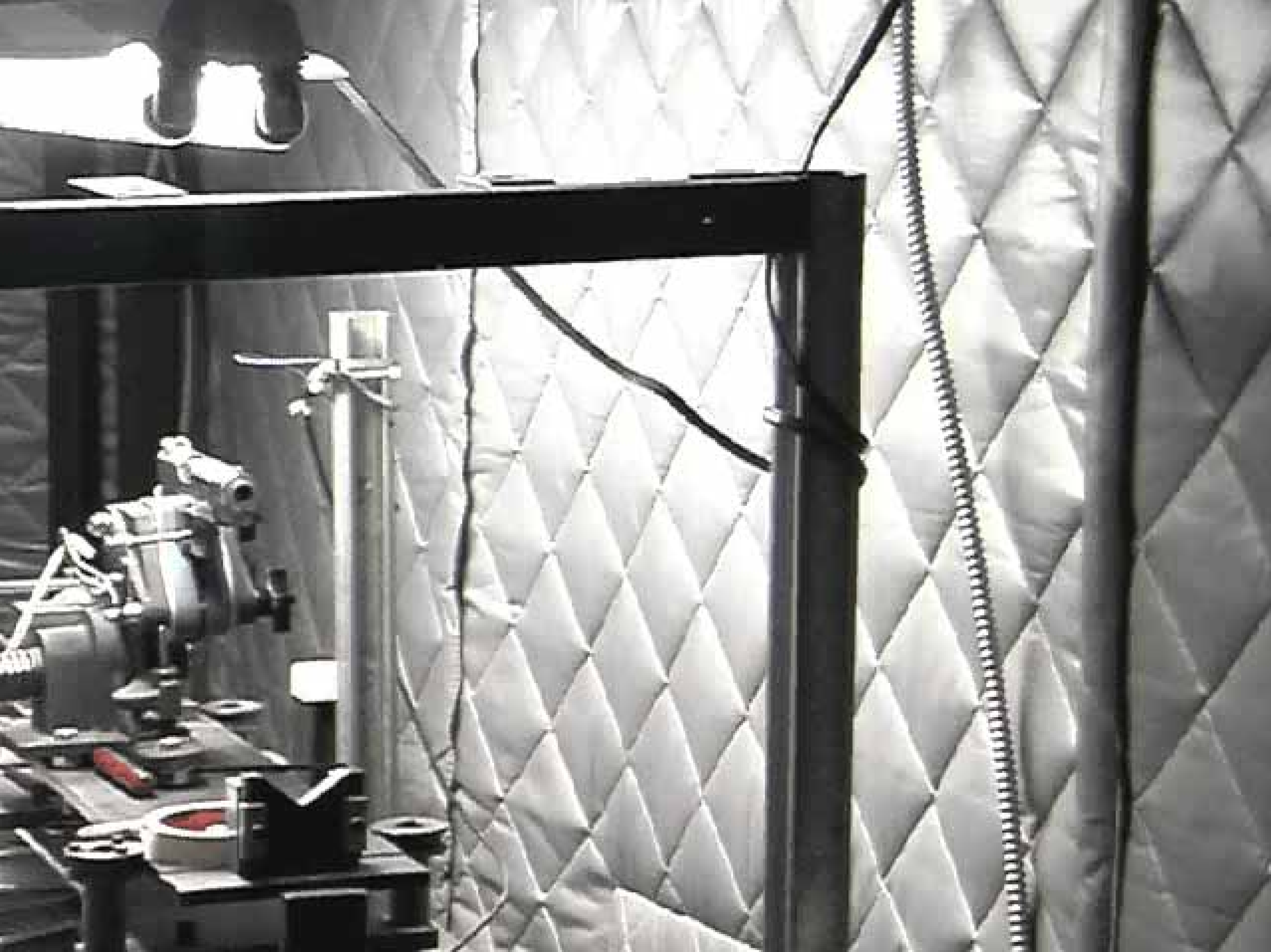
Much smaller visual nighttime firing signature

How Flashless?

There is no defined, quantitative method for analyzing muzzle flash.

Teamed up with Glen Perram’s group at AFIT Wright-Patterson AFB to create a method of analysis

- Experienced at analyzing the flash signature of large explosions.
- Broad array of light spectrum capture and analysis equipment
- Tests performed by Kevin C. Gross, Bryan J. Steward, Trevor W. Warren, Scott B. Ehman
- Coordinated by Mark J. Houle



Flash Testing

Analysis Equipment

Phantom 7.1 high speed camera
    High speed visible imaging
Cannon XL-1 Video Camera
    Mounted above the barrel

Two Fleur-Indigo Alpha NIR Camera
    Near IR imaging
ABB Bomem MR 154 FT spectrophotometer
    Measuring 500 – 6,000 cm-1
ABB Bomem MR 254 FT spectrophotometer
    Measuring 1,800 – 10,000 cm-1
    Analyzed combustion byproducts
Acton 0.25mm Grating Spectrophotometer
    450 – 900 cm-1

Flash Testing Results

Ammunition was originally limited to non-lead, frangible bullets by WP-AFB range regulations

Lighter bullets burn differently, created brighter flashes. Q30 Bullets 1/2 to 1/3 as bright in visible spectrum with same cartridge and bullet.

Q30 with 230 grain bullets were ~1/2 to 1/4 as bright as lighter Q30 bullets.

Near IR imagers had difficulty catching the flash, all imagers need faster settings.

Image analysis by area and pixel intensity were very effective, both in visible and near-IR.

Technologies to Products – *on the Leading edge*

Flashless Powder

Phantom High Speed Visible Camera

Standard 125 grain bullet

Q30 125 grain bullet

Q30 230 grain bullet

Future Flash Analysis

Planning second test series with Glen Perram's group

- Military 230 grain ammunition vs. Q30 230 grain ammunition
- Faster camera settings
- More shots for better spectrophotometer resolution

5.56 Development Status

Extruded M30 is very close to a ballistic match.

- 3000 fps muzzle velocity, 64,000 KPSI chamber Pressure
- Geometry can give ~10% performance variation
- M30 may simply be too fast for rifle, but is a good pistol powder.
- Testing other propellants, either alone or mixed
- May test additives, but probably cost prohibitive for production

Development Status

- .45 ACP Powder development complete. Developing interest with military users and commercial ammunition manufacturers.
- 5.56-mm Powder formulation is close to a match. Now extruding propellants to better control surface area and geometry.
- Teaming with AFIT to quantify flash suppression
- TPL in discussion with ammunition manufacturers for 45 ACP and 5.56mm qualification.

Future Development

- Test other powders and mixes of powders in the demil inventory
- Examine 7.62mm, .50 Cal rifle applications
- Reexamine near misses in pistol calibers, particularly 9mm, 10mm and .357 Magnum.
- Partner with ammo manufacturer to qualify 45 ACP, 5.56 mm
- Scale-up and automate extruded powder production

Technologies to Products – *on the Leading edge*

TPL's "Flashless" Powder for Small Arms Ammo has the Potential to Improve Soldier Combat Effectiveness & Increase Soldier and Police Officer Survivability

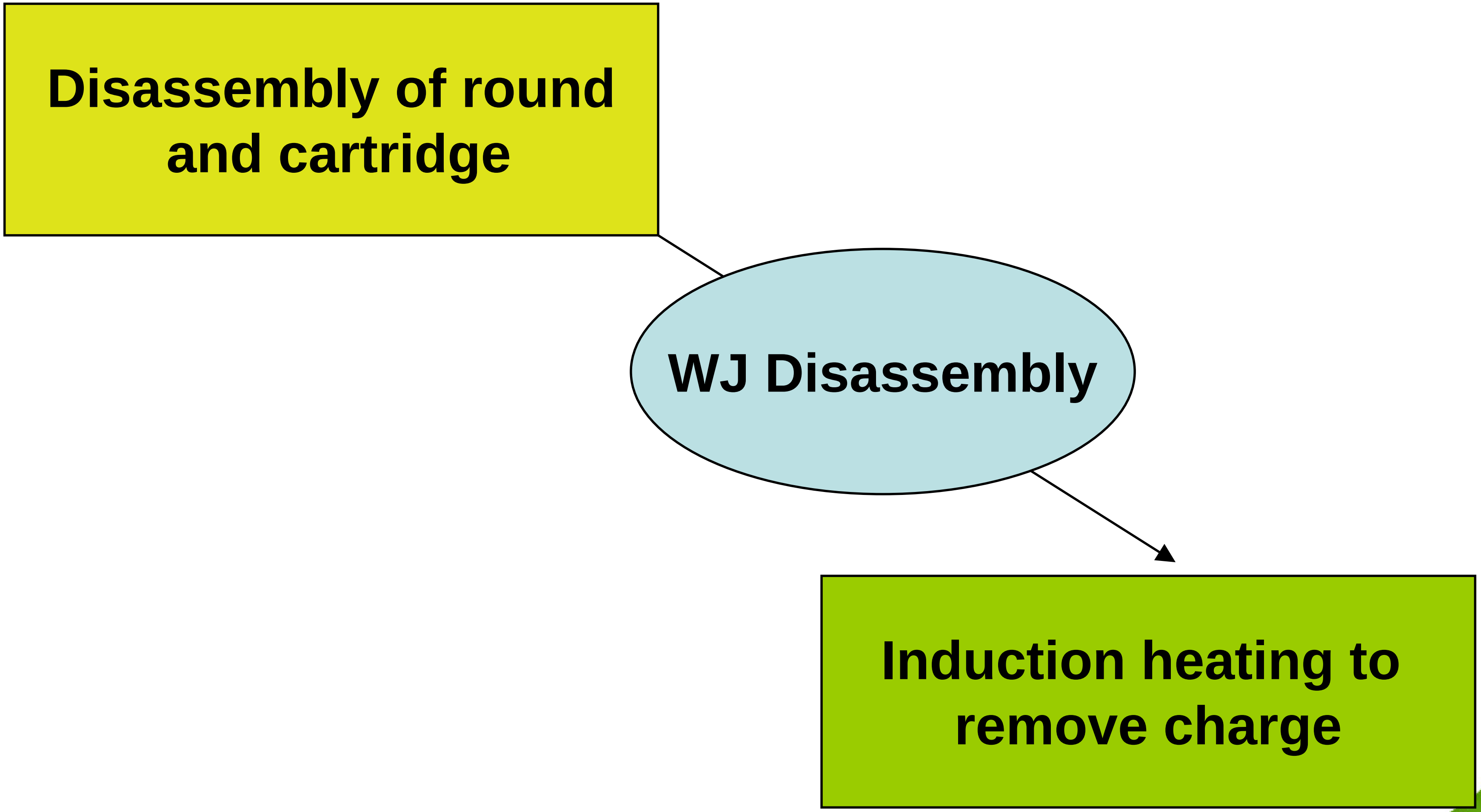
TPL, Inc. • 3921 Academy Parkway North, NE • Albuquerque, NM 87109

Validating the Performance of an Integrated Waterjet Cutting Fixture

Greg Galecki, L. J. Tyler, Robert Fossey, Dave Summers,
University of Missouri-Rolla

M.E. Johnson, Naval Surface Warfare Center - Crane Division
Crane, IN

The Waterjet system must fit between two steps in the Demilitarization By Inductive Heating Meltout (DIHME) system



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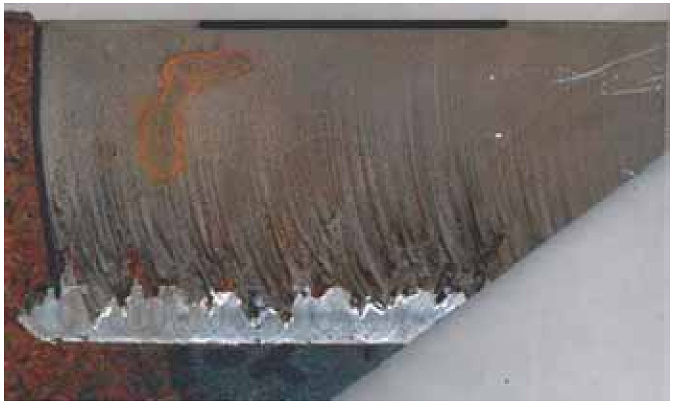
Abrasive waterjets have been found to be effective in cutting munitions

But can they meet the time criteria set by the system ?

Nozzle performance test geometry

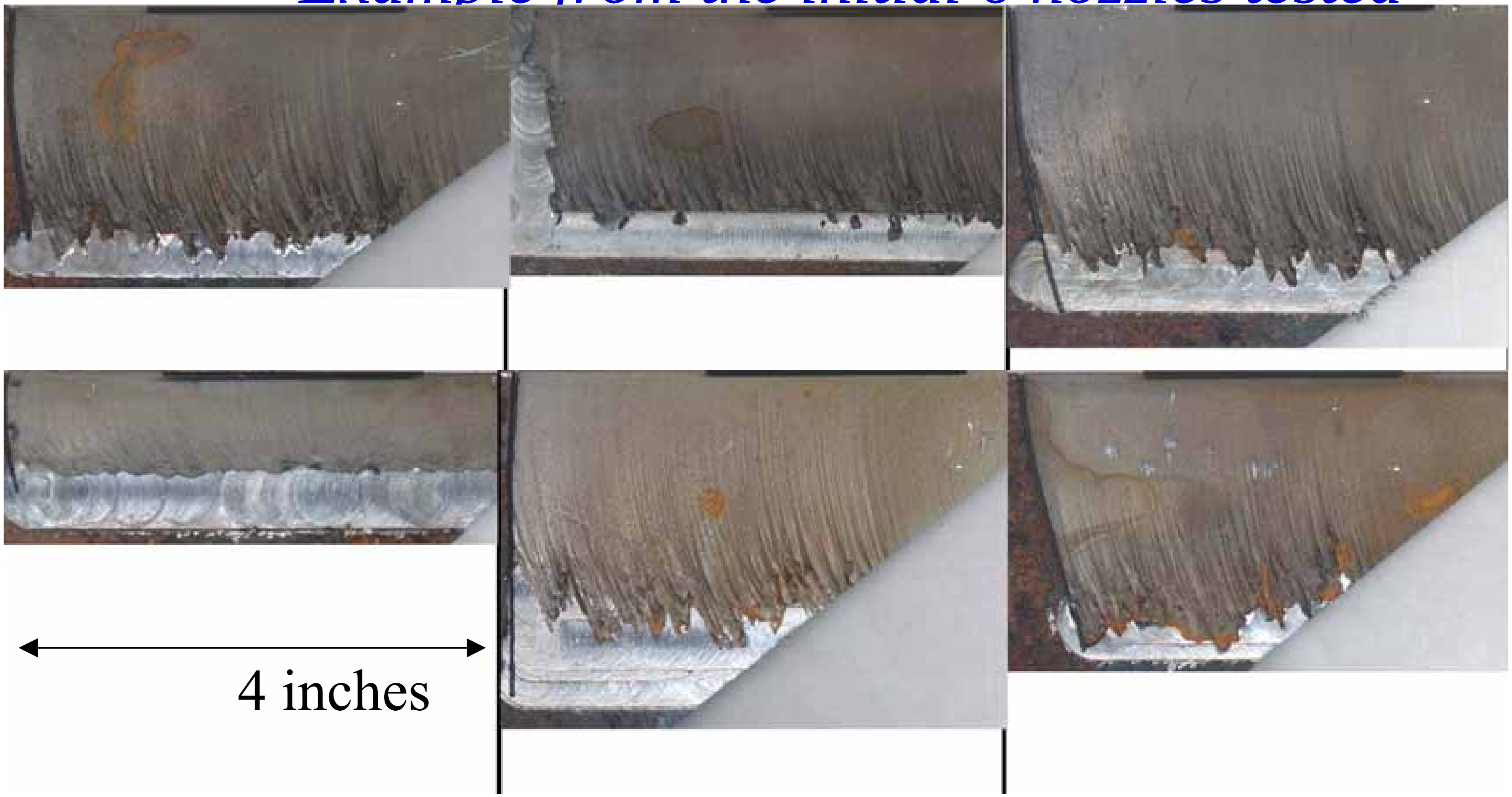
By determining the depth cut as a function pf cutting speed, we could develop a cutting performance production

Cut sample



Although not all nozzles could meet the standard.

Example from the initial 6 nozzles tested



Abrasive feed = 0.6 lb/min at 40,000 psi and 1.5 inch/minute

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Initial cost evaluation steps

- *Abrasive cost - $0.48/lb (to buy*
- *Abrasive disposal - $2.18/lb (flash, landfill)*
- *Water cost - $1.80/kgal*
- *Water disposal - $0.04/gal (carbon treatment)*
- *Energy cost - $0.20/kWhr.*

a) Dan Burch, John Griggs, Mike Johnson, Greg Olson, David Summers "Abrasive Waterjet Cutting Demilitarization of 40MM Projectiles"1999 Global Demilitarization Symposium & Exhibition, Tulsa, OK, May 20, 1999
b)Dan Burch, John Griggs, Mike Johnson Greg Olson, "Abrasive Waterjet Cutting Demilitarization of 40MM Projectiles", 2000 Global Demilitarization Symposium & Exhibition Coeur d'Alene, ID, May 18, 2000

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Comparison Table

Nozzle supplier	Age (min)	Projected Cut Depth	Cut Time (sec)	Abr. Per cut lb	Abr cost a cut	total cuts made	Nozzle cost a cut	Total Cut Cost
Carlosa	600	48.2	32.1	0.32	$0.85	1282	$0.10	$0.94
Flow	1290	47.2	32.9	0.33	0.88	2530	$0.11	$0.99
Ingersoll	1260	52.1	29.3	0.29	$0.78	2772	$0.05	$0.83
IWJP	990	48.5	31.9	0.32	$0.85	2090	$0.07	$0.91
Jet Edge	270	30.8	54.0	0.54	$1.44	380	$0.41	$1.86
Omax	810	50.2	30.6	0.30	$0.81	1875	$0.11	$0.91

Note the high proportion of the cost that is abrasive.

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UMR designed and build a prototype fixture to:

- Section 4 x 40mm rounds simultaneously
- Develop a concept that can work for rounds in the size range from 20mm to 120mm.
- Rotate the rounds during cutting
- Make 2 cuts, to remove fuze and tracer ends
- Trim the ends to remove protruding TNT.
- Separate the cut parts to remove loose material
- Place the parts so that they can be picked up.

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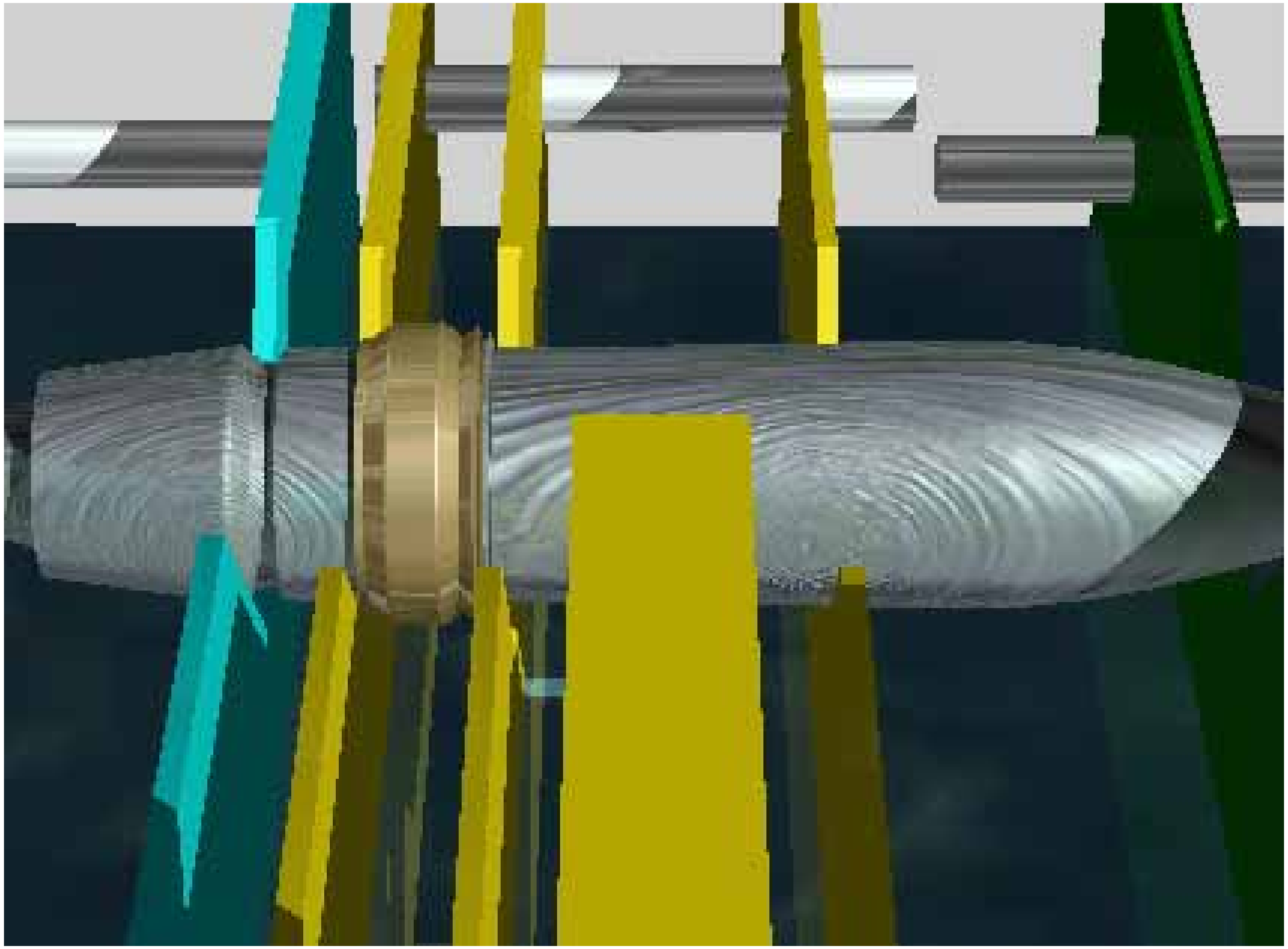
Initial Design



The slats are color coded for tracer (blue), body(yellow), and fuze end (green) supports

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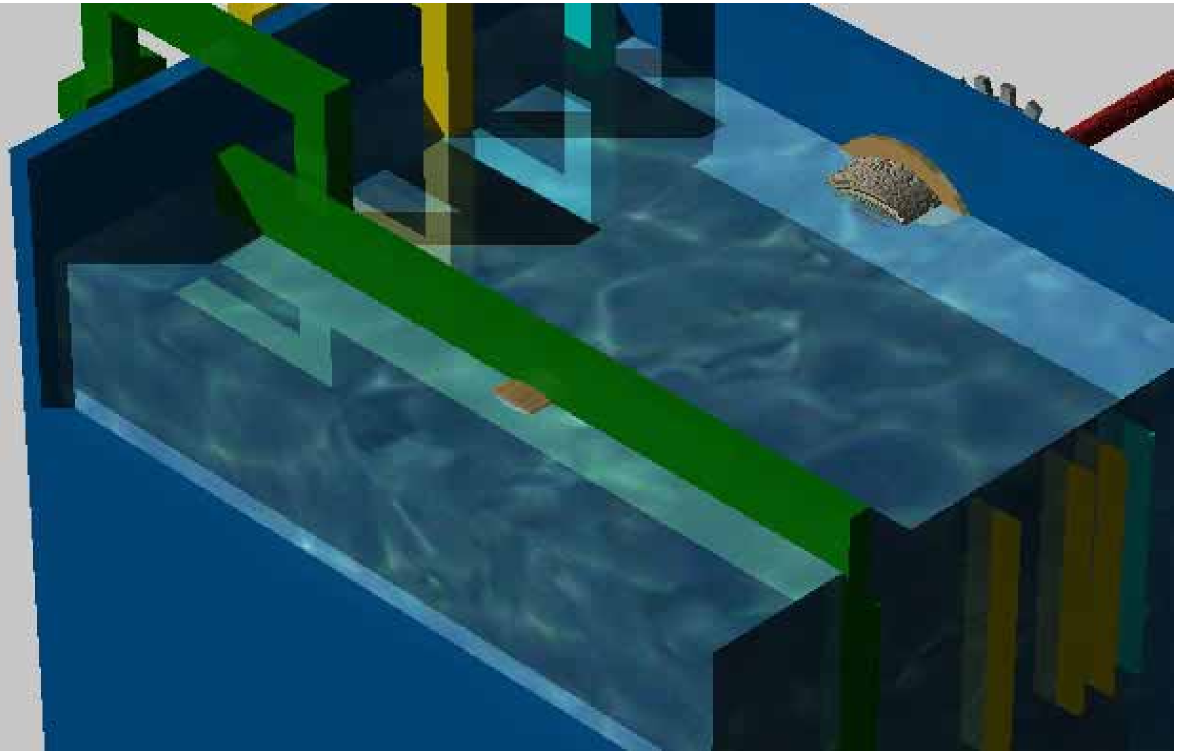
Must be able to rotate the rounds in the range from 1 - 25 rpm.

- Moving the rotating mechanism forward to grip and rotate the round requires a complex sealing structure.
- The rotation must take place with the presence of abrasive and high pressure water during cutting.
- Any gripping mechanism must also cope with the presence of abrasive in the surrounding water.
- The cutting will take place under water.

To control noise, and collect the abrasive, the shell is submerged, for cutting.



Note

Raising the water level is a standard procedure in cutting tanks and requires an air inflated bladder in a protected position in the tank.

The system was designed by DAC, built around an OMAX cutting table

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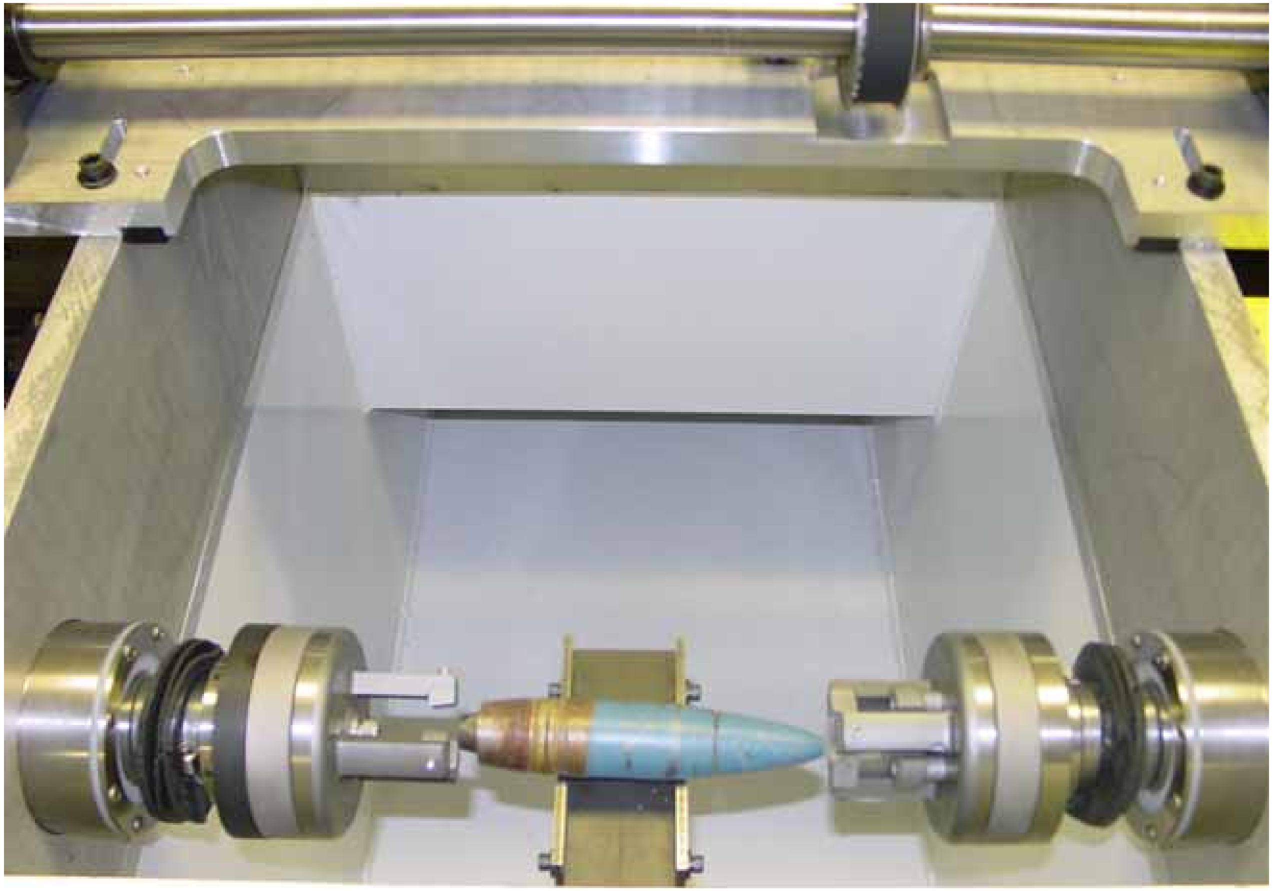
The initial system used 2 diaphragm chucks to grip and a drive that rotated the shells from both ends.



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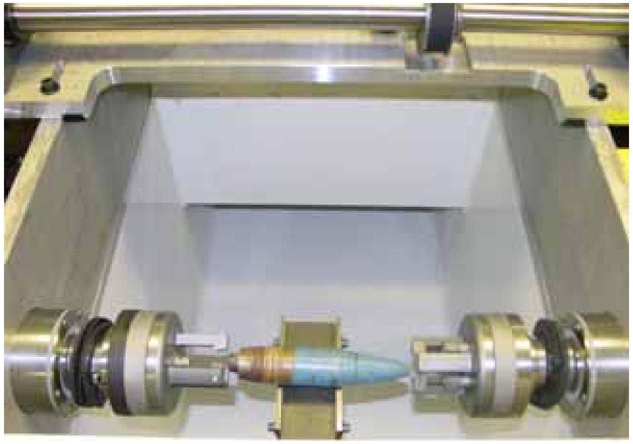
Requirements

- *The four 40 mm rounds must be on a 5 inch centerline to centerline distance.*
- *The longitudinal centerline axis of the four 40mm rounds must be located at 36” above the floor.*
- *The waterjet nozzles need to be 1” below the waterline during the cutting operations.*
- *Must have sensors that indicate when cuts have completed for each fuse/tracer on each round.*
- *Must interface with the waterjet robot end of arm tooling and hardware.*

The shell was manually loaded into the grippers



After cutting several thousand simulated shells the fixture has shown the strengths and weakness of the current design.

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Major Findings

- *Rotation speed was found to have the greatest impact on cutting time.*
- *The cutting head position has a strong influence on cutting time.*
- *The abrasive feed rate had some impact on cutting time.*

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Observations from Linear Tests

- *Cutting at faster speeds may decrease the size and number of irregularities.*
- *Compounding irregularities affect the separation of the work piece.*
- *An optimal balance between cutting speed influenced depth of cut and irregularities may be found*

Proposed modification to existing holding and rotation fixture

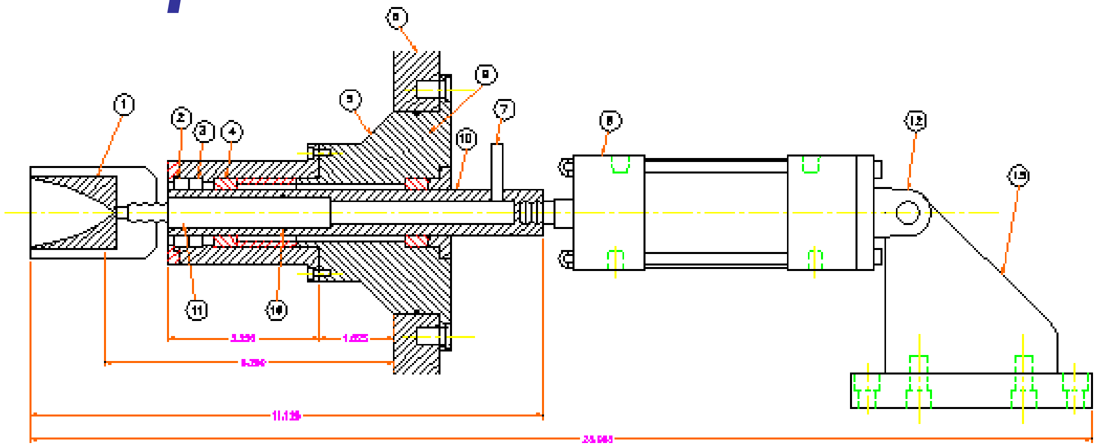

Figure 1

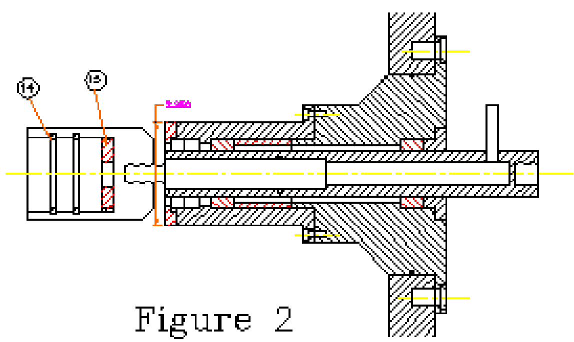

Figure 2

① — Rubber Cushion
② — Wiper
③ — Seal
④ — Guiding Ring
⑤ — Housing
⑥ — Existing Main Plate, RH
⑦ — Low pressure water inlet
⑧ — Stainless Steel Drop-in Tie Rod Air Cylinder has a bore size of 2" and maximum pressure of 250psi Stroke Lg. is 2"
⑨ — Adapter Housing
⑩ — Ram
⑪ — Self-rotating swivel – Wessel. Stenesge tools
⑫ — Clevis Bracket
⑬ — Support bracket made of 3/4" steel with 1/2" hole for pin. Attached to bottom plate with 3/8" allen bolts
⑭ — Friction Rings
⑮ — Magnet
⑯ — O-Ring

Notes:

- Drawing to Scale
- Motion for rotating components is in the clockwise direction for tighting threads
- For clarity of the drawing some details are not shown

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The fuse end chuck has been replaced with a new idling chuck assembly

The concept of maintaining the fuse end chuck as an idling component, significantly simplifies the mechanism.

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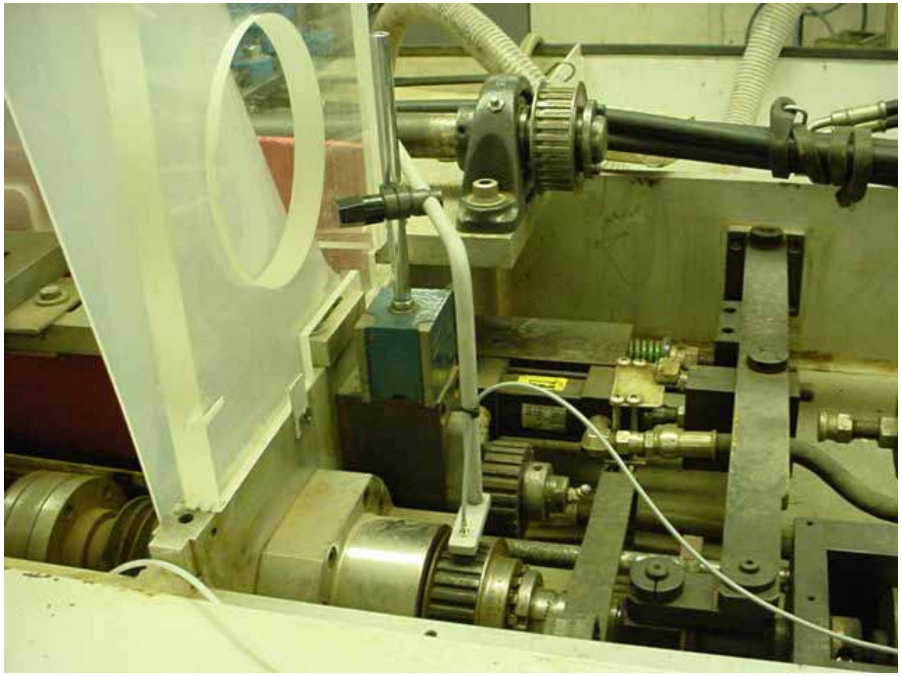
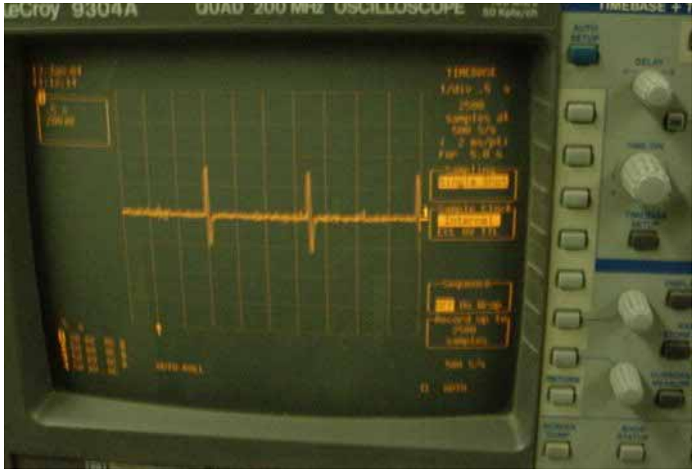
Fuse end – dry well



…before and after modifications.

Sensing technology for this aggressive environment was also a requirement



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The drive was changed from both ends to just rotate from the fuze end

Drive

By rotating from just one end, one can sense when the separation cuts are made, by noting when the rotation of the fuze and central sections of the munitions stop, as the drive becomes separated by the cut.

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Central section sensor

The central section sensor is located adjacent to the nozzles on the cutting bar, and lowered with them at the start of a cut.

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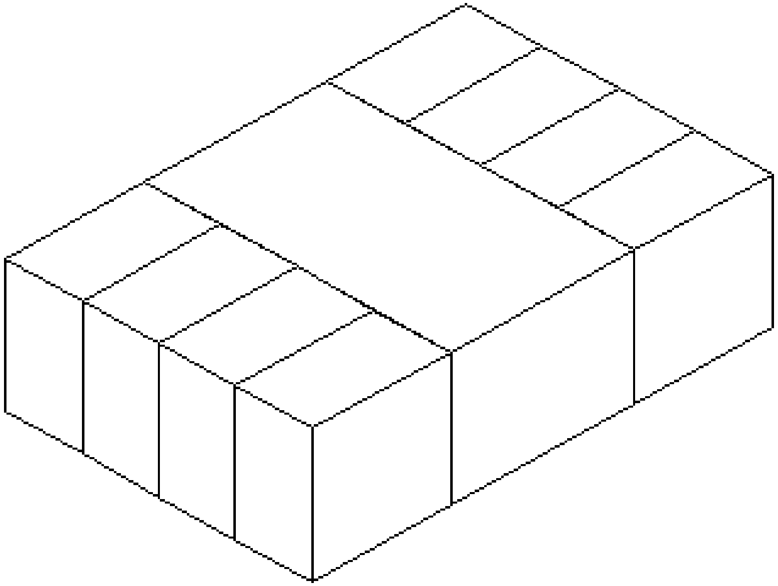
Conclusions:

- *A rotational speed of 20 rpm is recommended for process optimization.*
- *To simplify selection of an abrasive feed rate, an AFR of 0.62 lb/min is an industry standard for waterjet cutting.*
- *For an AFR of 0.62 lb/min the average cutting time is 22 sec.*
- *At this AFR the cutting head position does not influence the cutting time.*

Different combinations of drive and holder were assessed to cut 4 rounds at once



Advantages	Disadvantages
Easier to control water level	**Unit alignment issues**
Easier to clean water reservoir	**Harder to do unit maintenance**
An individual unit can be removed for repairs, others can still operate	

Four separate units with one single tank was judged the best.

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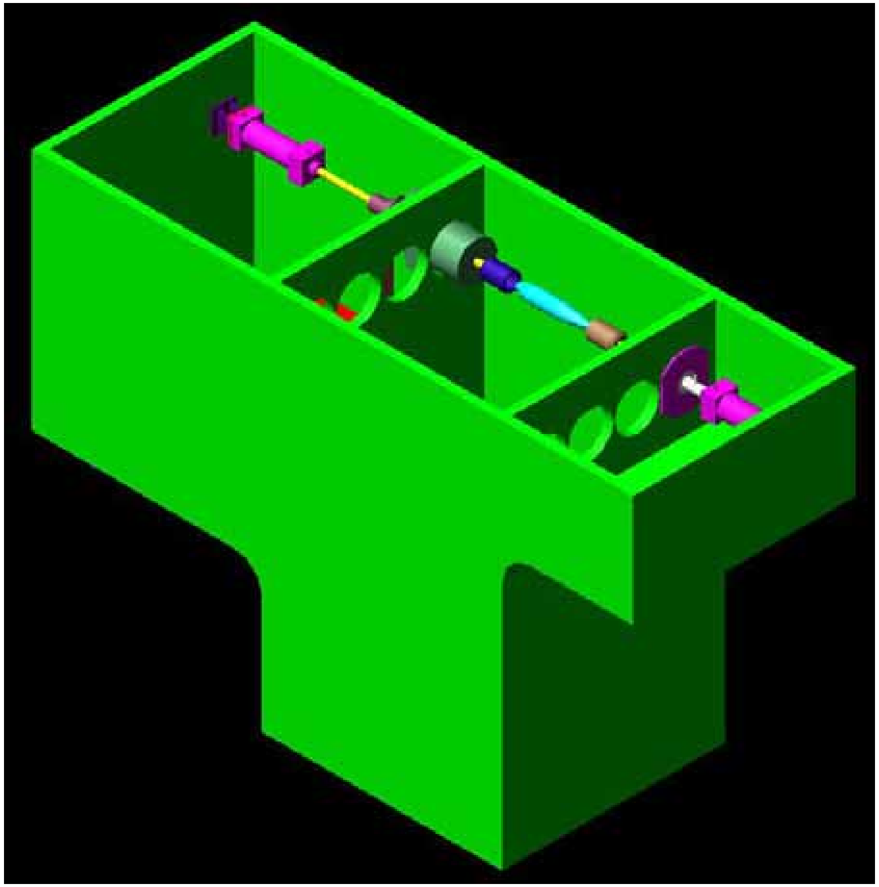
Design considerations:

- The longitudinal centerline axis of the four 40mm rounds must be located 36” above the floor



- The waterjet nozzles need to be 1” below the waterline during the cutting operations

- The four 40mm rounds must be on a 5 inch centerline to centerline distance

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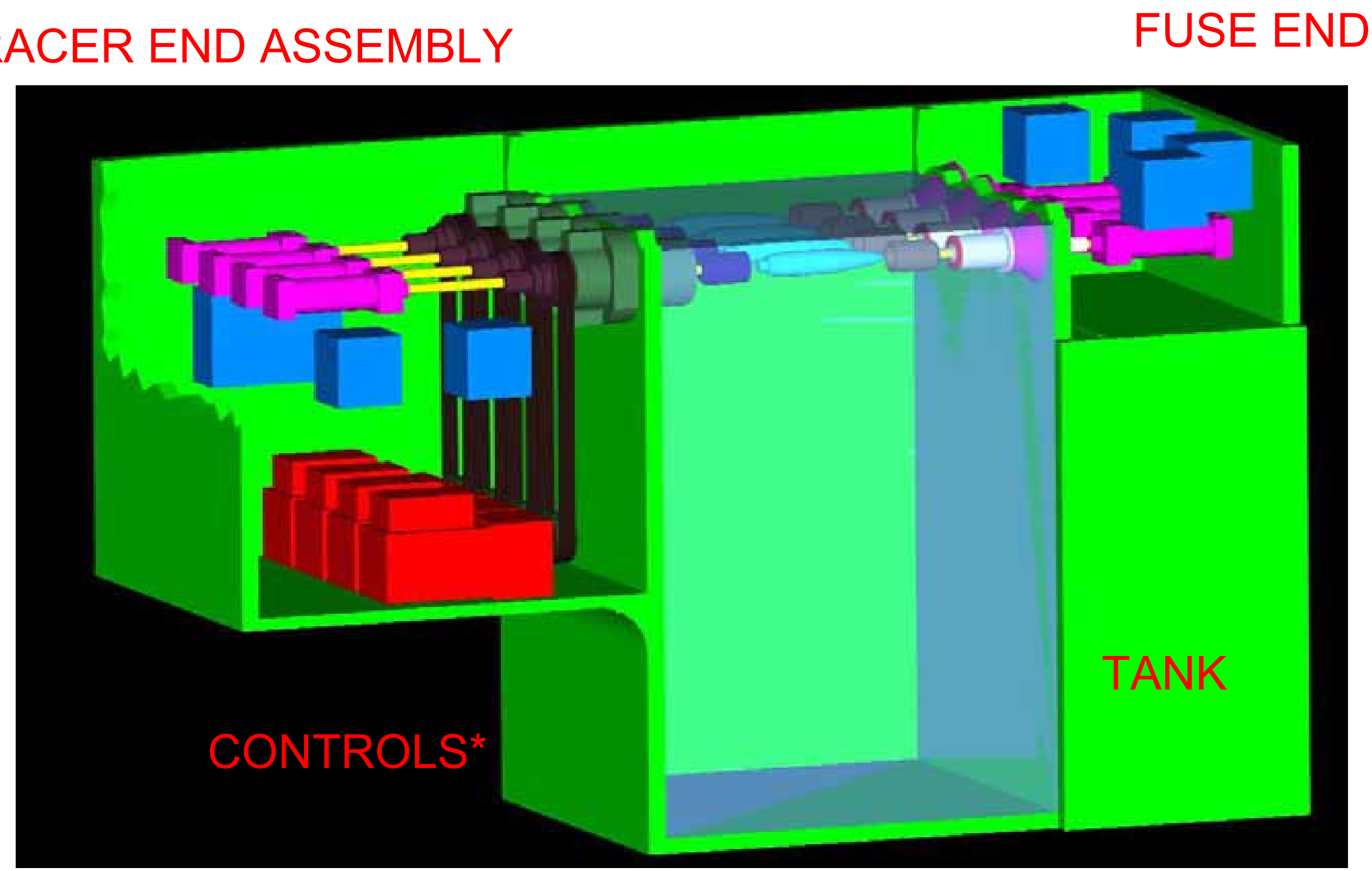
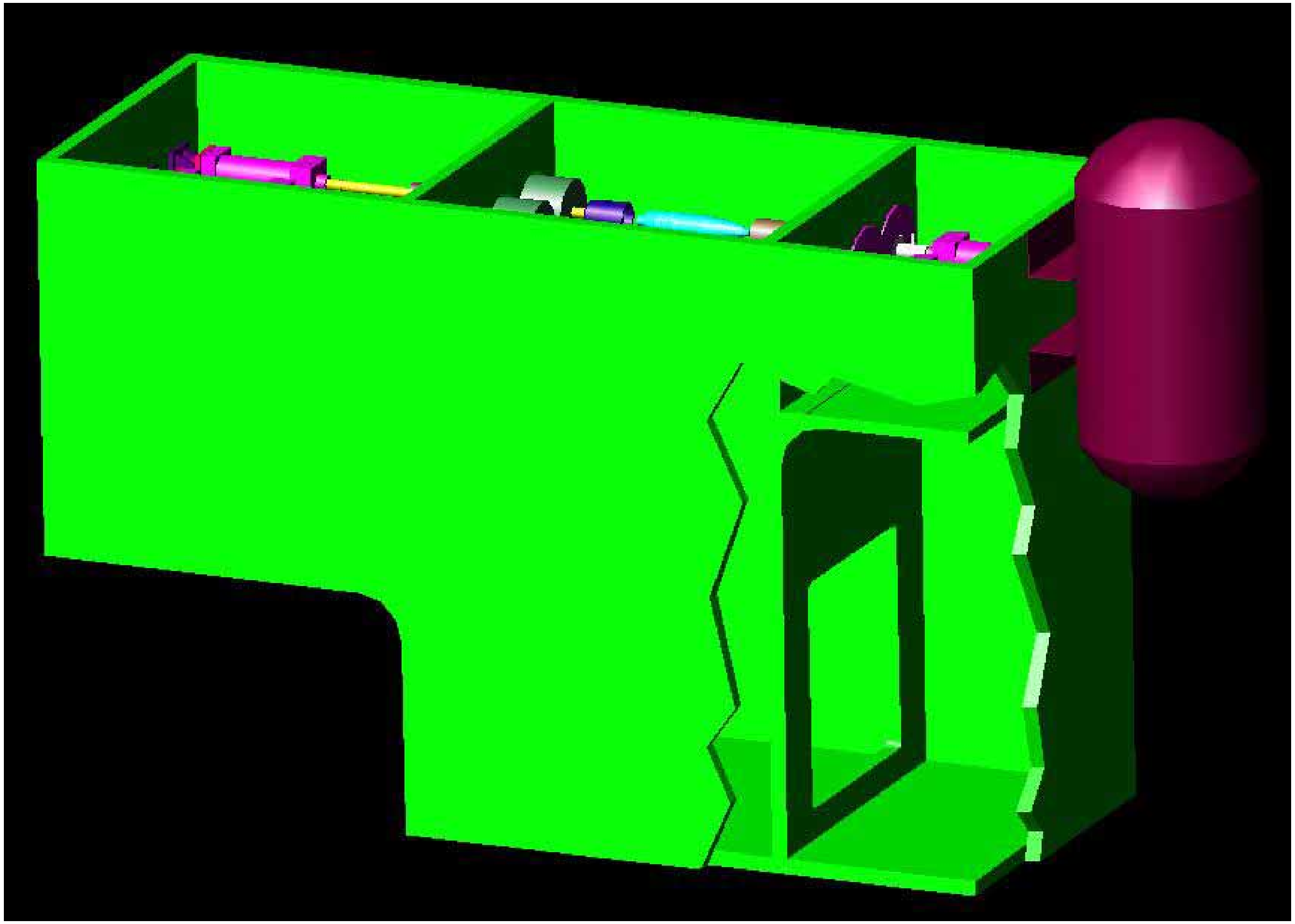
Fixture components



FUSE END CHUCK UMR01-xxx
TRACER END CHUCK UMR02-xxx
HOLDING TANK UMR03-xxx
CONTROLS*

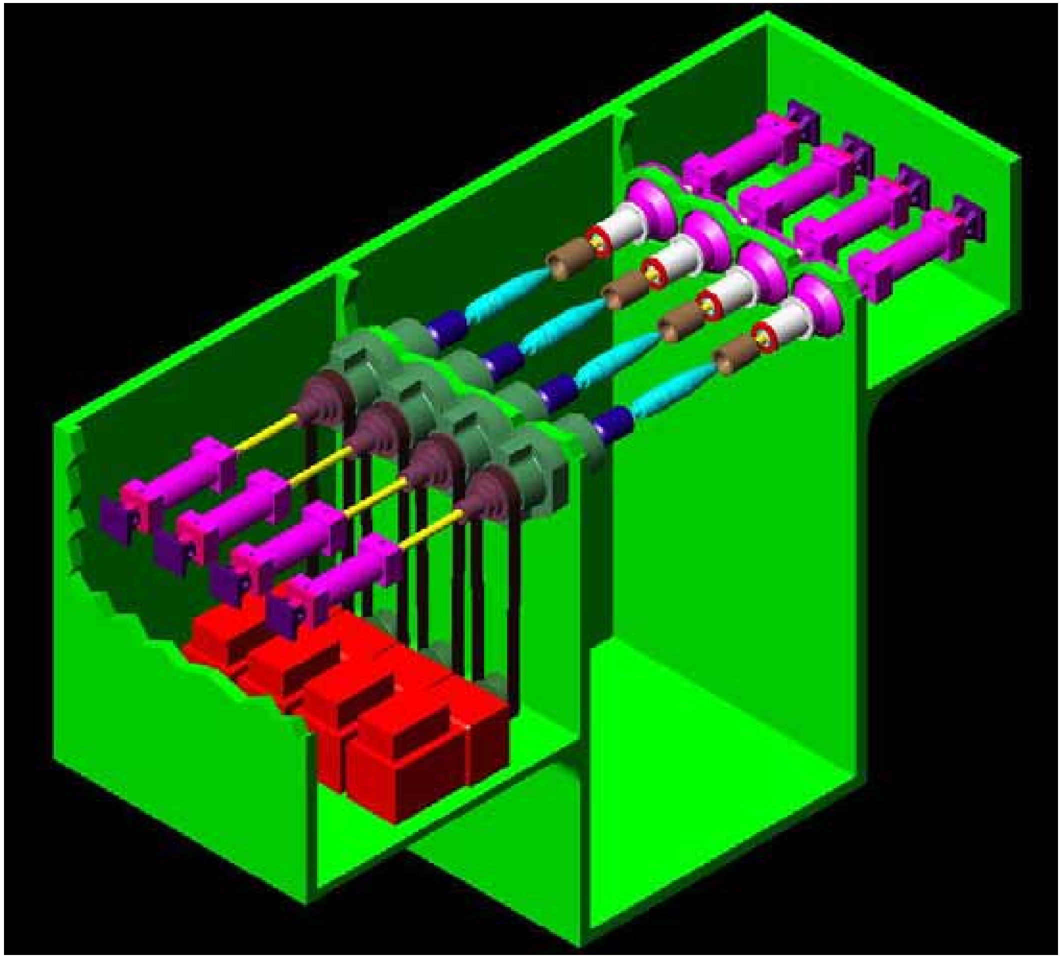
UNIVERSITY OF MISSOURI-ROLLA

Used garnet will be continuously removed during normal operation.



UMR

Drive location and components



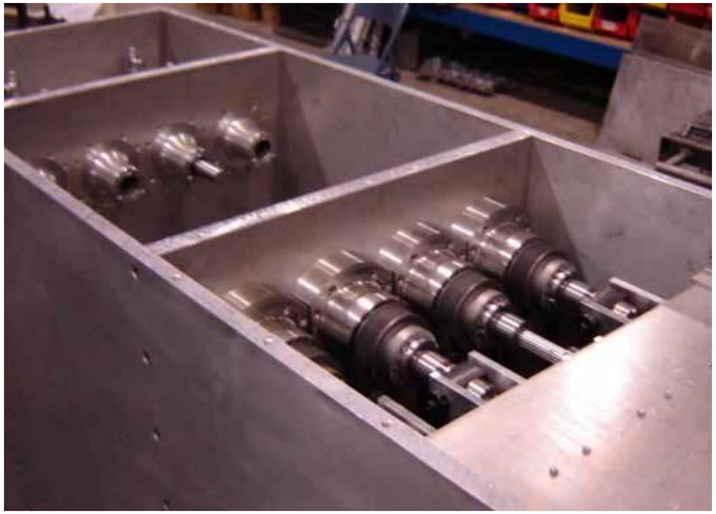
UMR

The Fuze end Chuck was modified

The insert can support the weight of the munition

UMR

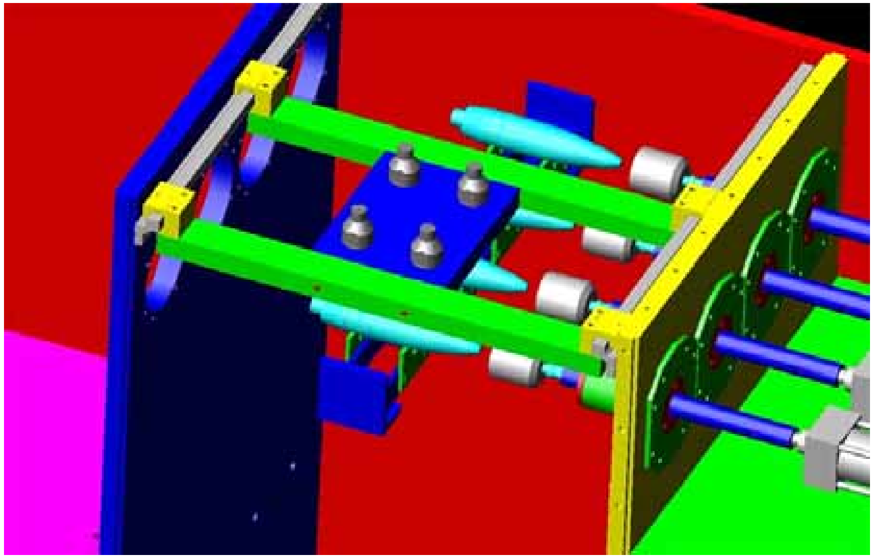
The Holding & Rotation Fixture has been built

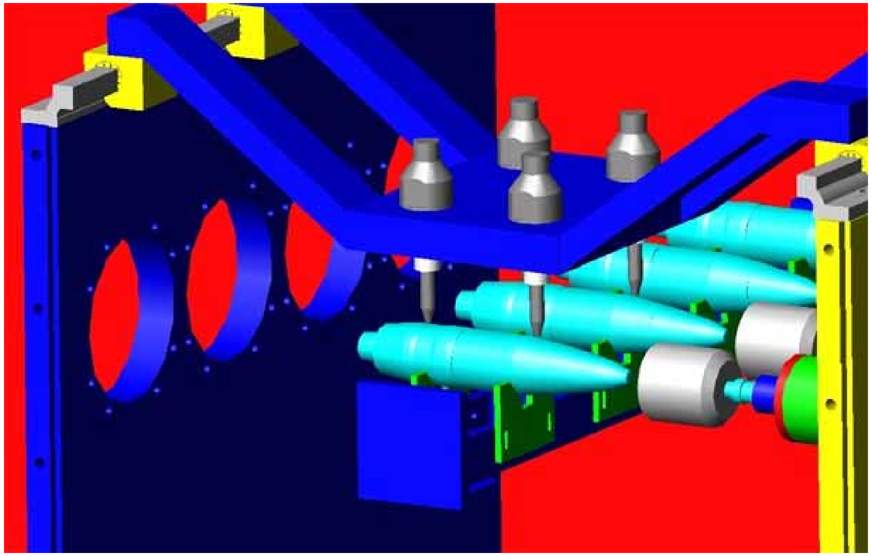


UMR

And, though the fixture will hold the 40-mm rounds, a new "test round" will be used.

Meanwhile the cutting head assembly is being tested in two configurations





Either a single sliding fixture of 4 nozzles, or a static array of 8 nozzles, with valve control, will be used, to make the 8 eight cuts. The benefits of the alternatives are currently being assessed.

UMR

Thank You for your kind attention

Closed Loop Processing of Energetics to Safely Eliminate Emissions

Brian Butters, P.Eng., MBA
Tony Powell, P.Eng.

Presentation Scope

- **The Challenge**
- Traditional Method
- As Built
- Operation
- Lessons Learned
- Conclusion

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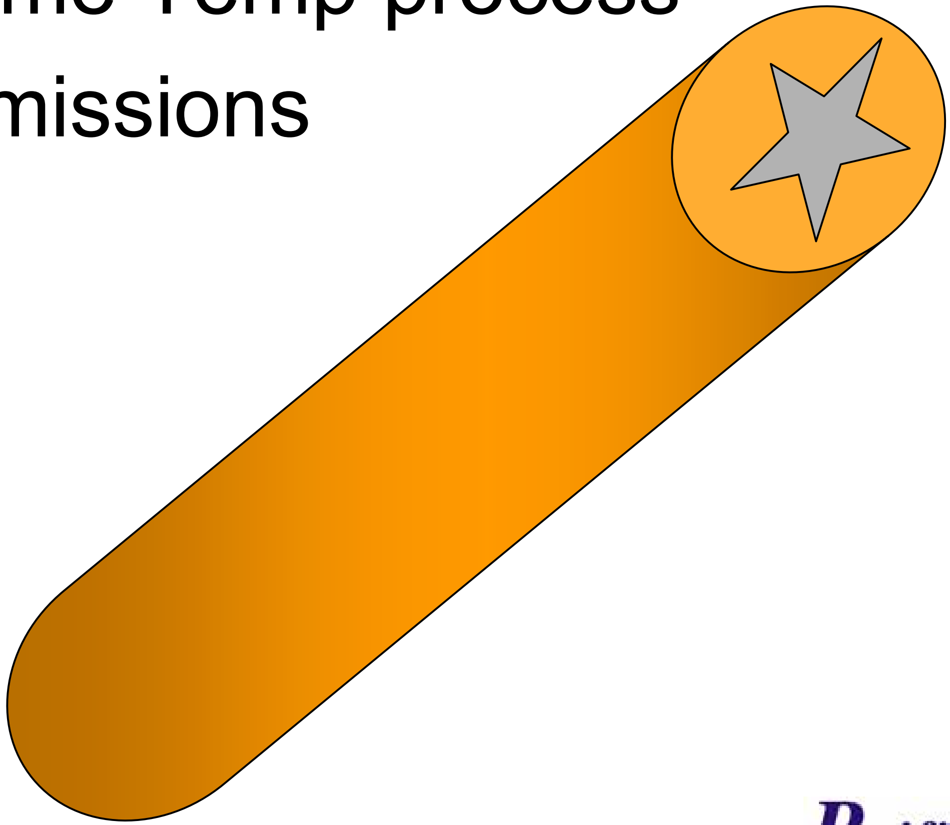
The Challenge

- Anneal Solid Rocket Motors
- Hot air driven: Time Temp process
- Generates Air Emissions
  - NG
  - Plasticizers



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Presentation Scope

- The Challenge
- **Traditional Method**
- As Built
- Operation
- Lessons Learned
- Conclusion

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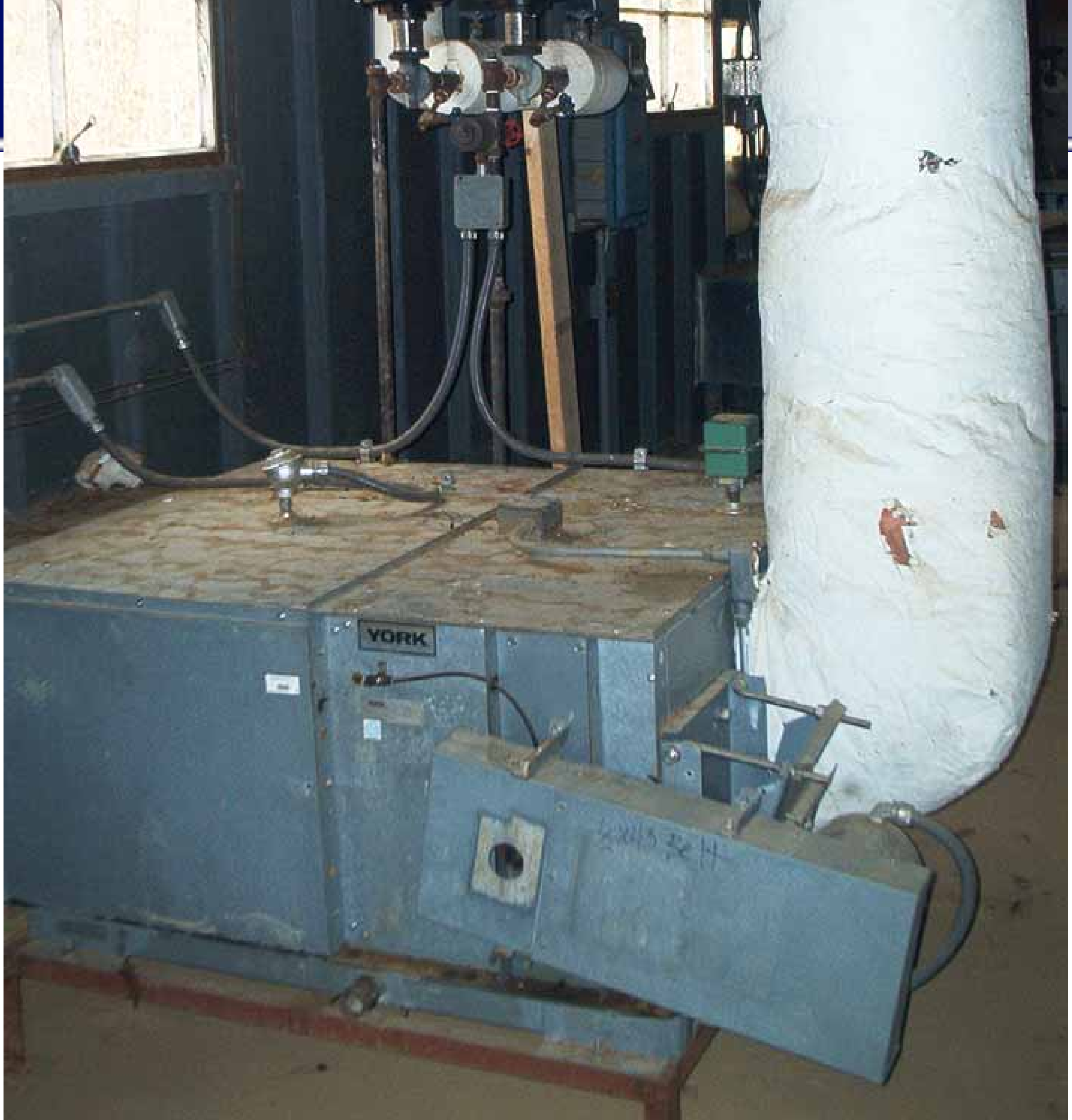
EMPTY
EMPTY



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Alternative Test Programs
www.Purifics.com

Photo-Cat Test Program Data

Influent	Effluent	Energy
404 ppm	0.28 ppm	158 kwh/m^3
409 ppm	18 ppm	79 kwh/m^3

- **pH 4** ←
- **Temp 38° C**
- **Other TOC Present**
- **Nitrates (block light) have no effect**

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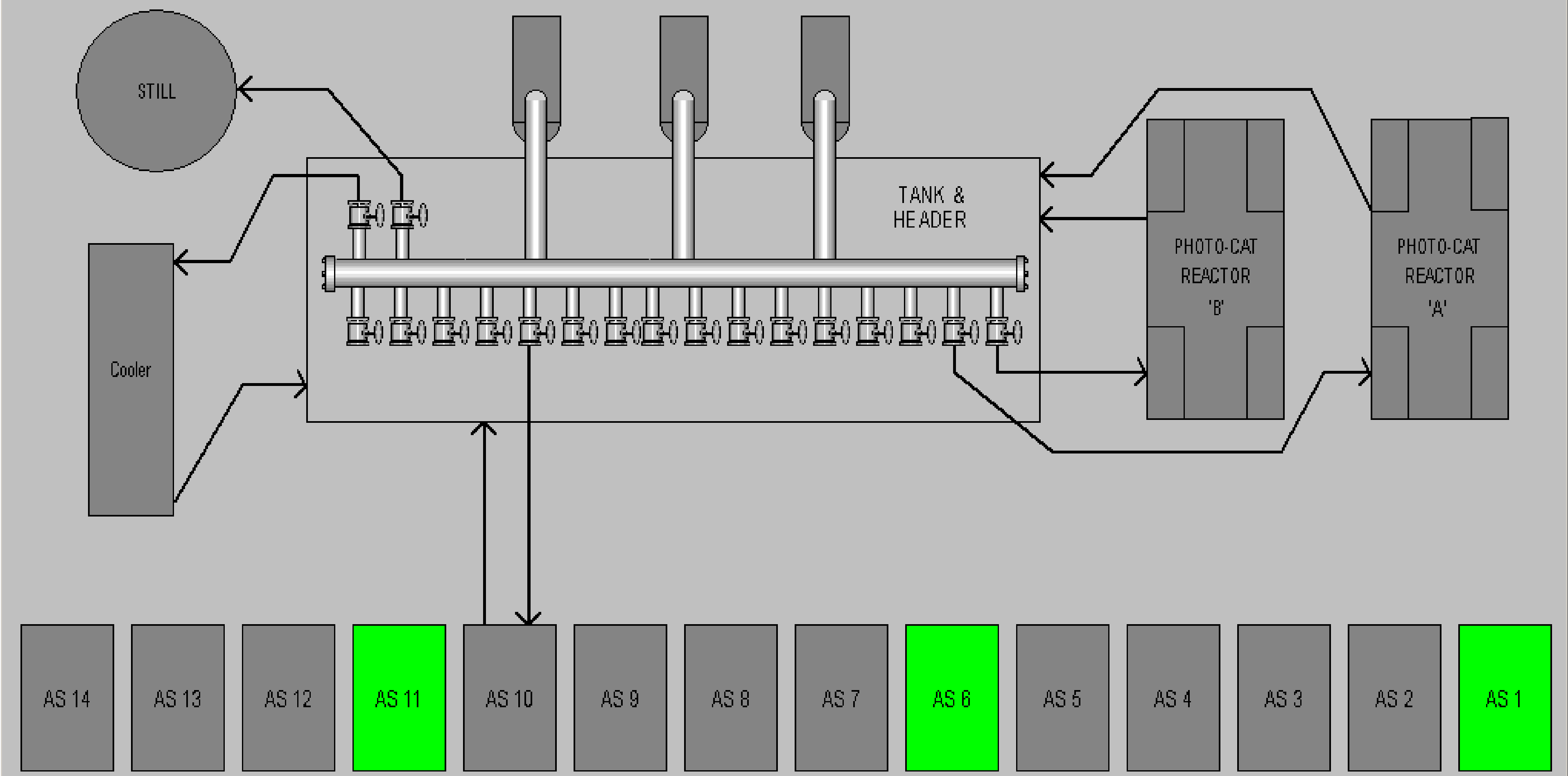
Presentation Scope

- The Challenge
- Traditional Method
- **As Built**
- Operation
- Lessons Learned
- Conclusion

As Built

- **Anneal NG-based Propellants**
- **Immediate Off-gas Treatment;**
  - **10,000cfm**
  - **50kg/day of NG**
- **Closed Loop Working Fluids**
- **Acid By-Product Recovered**
- **No NG Discharge to Environment**
- **Prevent Health & Explosion Hazards**

ANNEALING & POLLUTION CONTROL FACILITY



Emergency Stop | Facility | Annealing | Photo-Cat A | Photo-Cat B | Tank-Header | Still-Chiller | Tech. Support | Config. SP's | log off

www.PURIFICS.com

Logged On: Operator1

12 13

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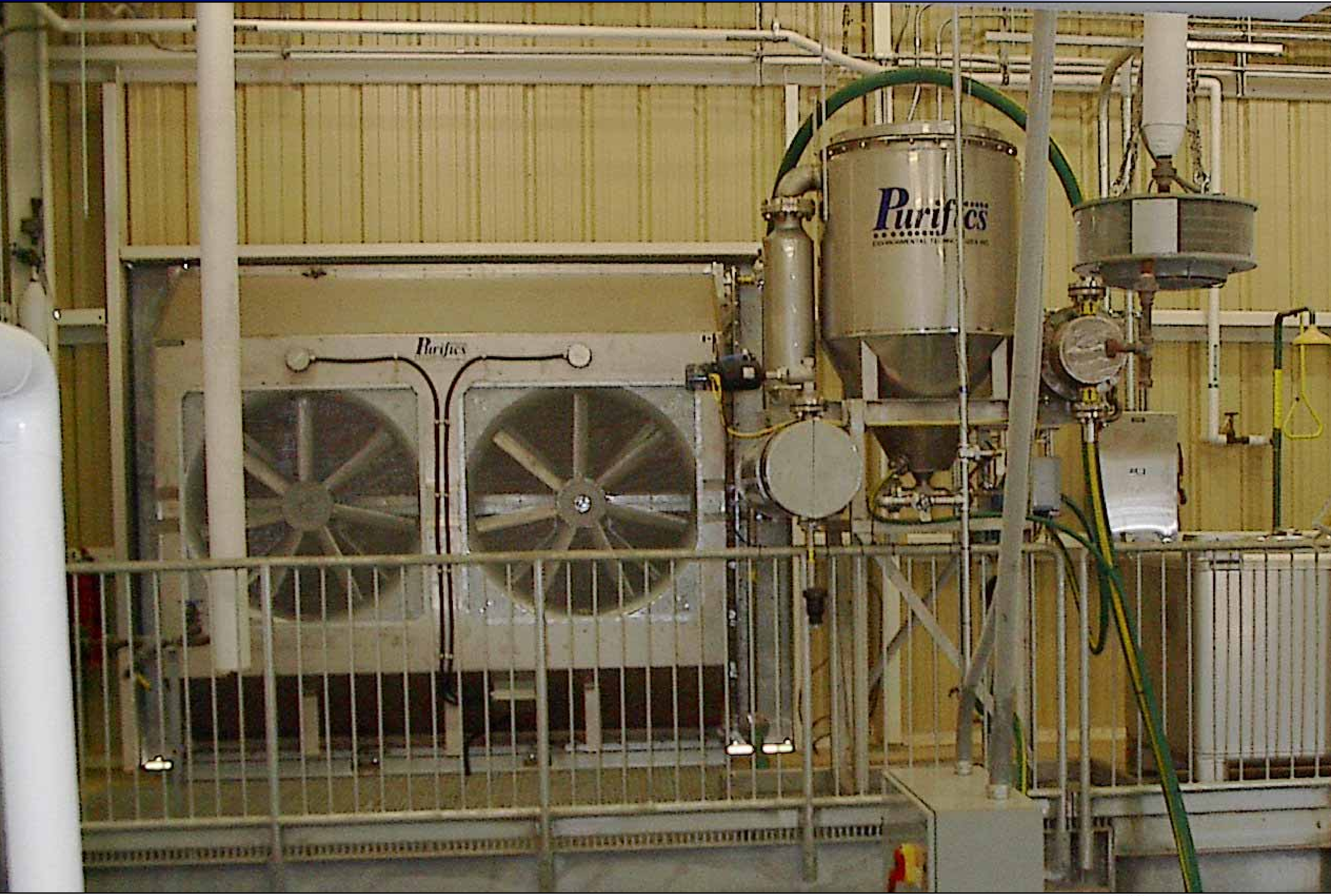
Photo-Cat® Systems



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Presentation Scope

- The Challenge
- Traditional Method
- As Built
- **Operation**
- Lessons Learned
- Conclusion

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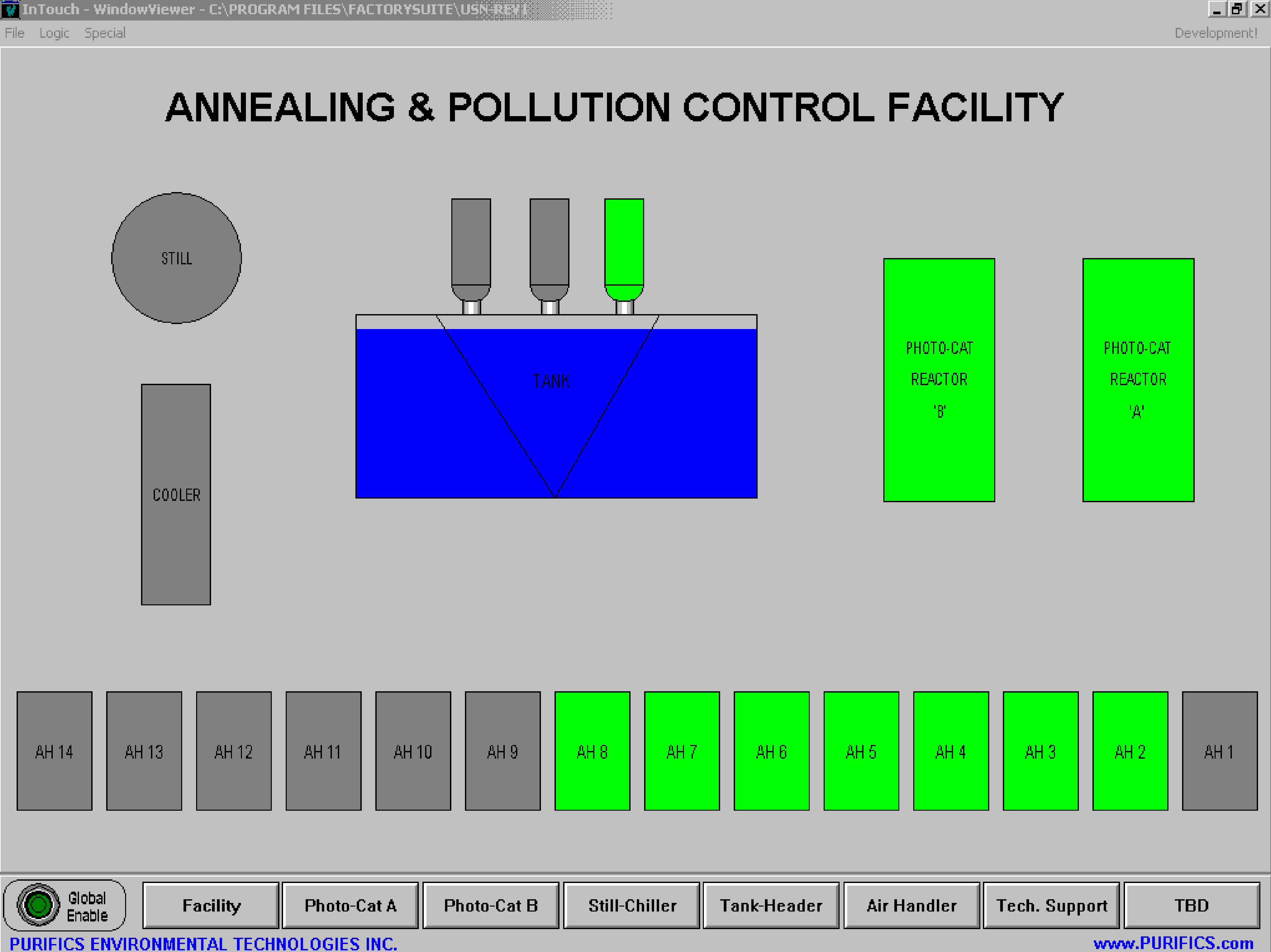
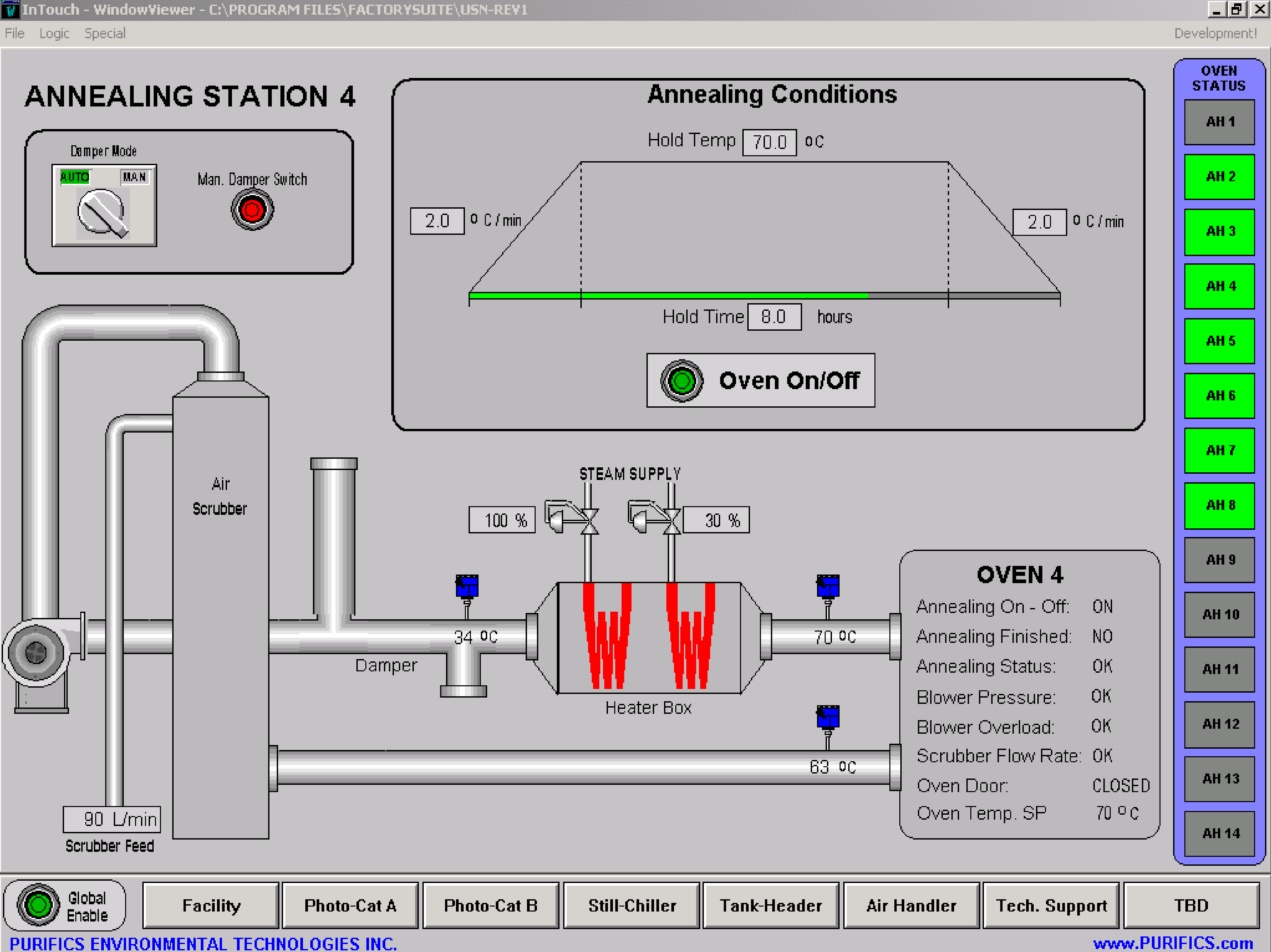

InTouch - WindowViewer - C:\PROGRAM FILES\FACTORYSUITE\USN-REV1
File Logic Special
Development!
ANNEALING & POLLUTION CONTROL FACILITY
STILL
COOLER
TANK
PHOTO-CAT REACTOR 'B'
PHOTO-CAT REACTOR 'A'
AH 14
AH 13
AH 12
AH 11
AH 10
AH 9
AH 8
AH 7
AH 6
AH 5
AH 4
AH 3
AH 2
AH 1
Global Enable
Facility
Photo-Cat A
Photo-Cat B
Still-Chiller
Tank-Header
Air Handler
Tech. Support
TBD
PURIFICS ENVIRONMENTAL TECHNOLOGIES INC.
www.PURIFICS.com


InTouch - WindowViewer - C:\PROGRAM FILES\FACTORYSUITE\USN-REV1
File
Logic
Special
Development!
ANNEALING STATION 4
Damper Mode
AUTO
MAN
Man. Damper Switch
Annealing Conditions
Hold Temp
70.0
0C
2.0
0 C / min
2.0
0 C / min
Hold Time
8.0
hours
Oven On/Off
OVEN STATUS
AH 1
AH 2
AH 3
AH 4
AH 5
AH 6
AH 7
AH 8
AH 9
AH 10
AH 11
AH 12
AH 13
AH 14
Air Scrubber
STEAM SUPPLY
100 %
30 %
34 0C
70 0C
63 0C
Damper
Heater Box
90 L/min
Scrubber Feed
OVEN 4
Annealing On - Off: ON
Annealing Finished: NO
Annealing Status: OK
Blower Pressure: OK
Blower Overload: OK
Scrubber Flow Rate: OK
Oven Door: CLOSED
Oven Temp. SP 70 0C
Global Enable
Facility
Photo-Cat A
Photo-Cat B
Still-Chiller
Tank-Header
Air Handler
Tech. Support
TBD
PURIFICS ENVIRONMENTAL TECHNOLOGIES INC.
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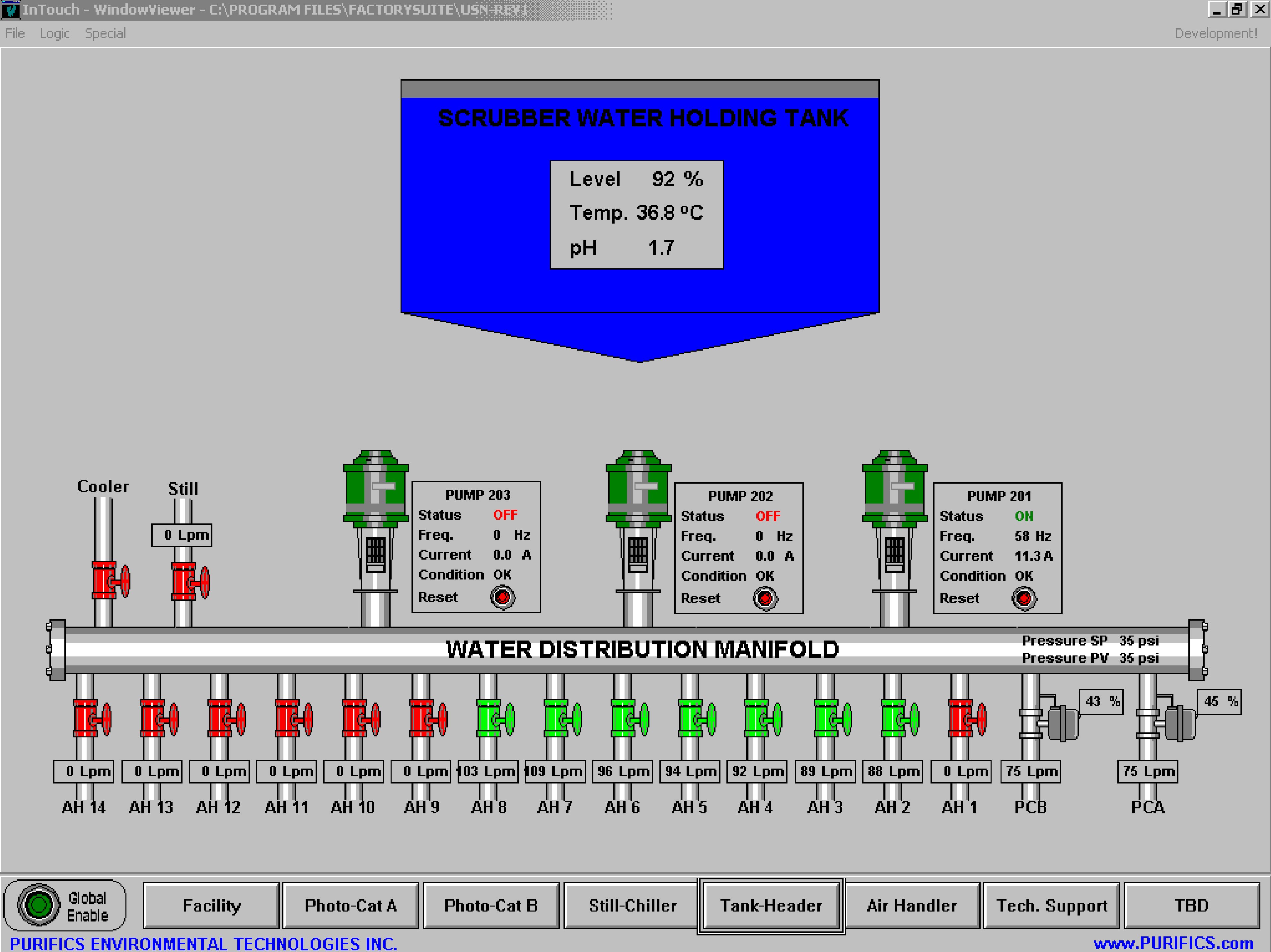
InTouch - WindowViewer - C:\PROGRAM FILES\FACTORYSUITE\USN-REV1
File Logic Special
Development!
SCRUBBER WATER HOLDING TANK
Level 92 %
Temp. 36.8 °C
pH 1.7
Cooler
Still
0 Lpm
PUMP 203
Status OFF
Freq. 0 Hz
Current 0.0 A
Condition OK
Reset
PUMP 202
Status OFF
Freq. 0 Hz
Current 0.0 A
Condition OK
Reset
PUMP 201
Status ON
Freq. 58 Hz
Current 11.3 A
Condition OK
Reset
WATER DISTRIBUTION MANIFOLD
Pressure SP 35 psi
Pressure PV 35 psi
43 %
45 %
0 Lpm AH 14
0 Lpm AH 13
0 Lpm AH 12
0 Lpm AH 11
0 Lpm AH 10
0 Lpm AH 9
103 Lpm AH 8
109 Lpm AH 7
96 Lpm AH 6
94 Lpm AH 5
92 Lpm AH 4
89 Lpm AH 3
88 Lpm AH 2
0 Lpm AH 1
75 Lpm PCB
75 Lpm PCA
Global Enable
Facility
Photo-Cat A
Photo-Cat B
Still-Chiller
Tank-Header
Air Handler
Tech. Support
TBD
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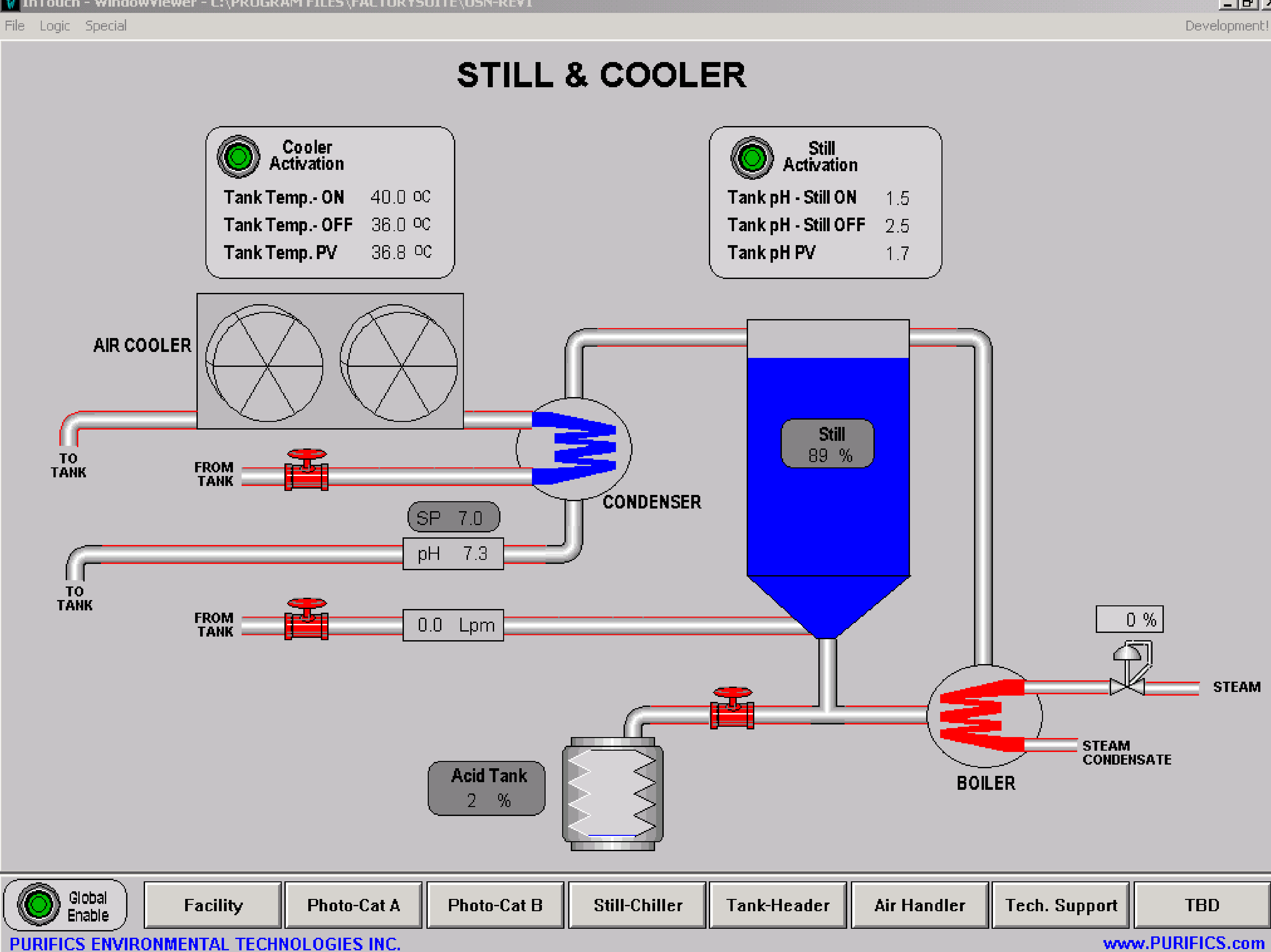
InTouch - WindowViewer - C:\PROGRAM FILES\FACTORYSUITE\USN-REV1
File Logic Special
Development!
STILL & COOLER
Cooler Activation
Tank Temp.- ON 40.0 oC
Tank Temp.- OFF 36.0 oC
Tank Temp. PV 36.8 oC
Still Activation
Tank pH - Still ON 1.5
Tank pH - Still OFF 2.5
Tank pH PV 1.7
AIR COOLER
TO TANK
FROM TANK
CONDENSER
Still 89 %
SP 7.0
pH 7.3
TO TANK
FROM TANK
0.0 Lpm
0 %
STEAM
STEAM CONDENSATE
BOILER
Acid Tank 2 %
Global Enable
Facility
Photo-Cat A
Photo-Cat B
Still-Chiller
Tank-Header
Air Handler
Tech. Support
TBD
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Presentation Scope

- The Challenge
- Traditional Method
- As Built
- Operation
- **Lessons Learned 2003-2006**
- Conclusion

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Lessons Learned #1

- The Process Works
- Operated as Low as 0.8 pH
  - To max efficiency of still
- Exceeded Materials of Design Spec.
  - Successfully

Lessons Learned #2

- If Low pH air is a Concern in Closed Loop
- Operate at Neutral pH

Lessons Learned #3

- Lock Out Code Changes
- Oxidant Source Turned Off
- Resulted in Extended Operation Without Purification
- Enhance Instrumentation & Training

Lessons Learned #4

- Stick to the Proven Results
- Extreme pH swings without purification can cause precipitates
- Return to baseline operating conditions

Presentation Scope

- The Challenge
- Traditional Method
- As Built
- Operation
- Lessons Learned
- **Conclusion**

Purifics.com

Conclusion

- Technology is Broadly Applied
- It is Proven
- It is Mature
- High Reliability & Durability
- Mass Transfer Solved
- High Efficiency
- Simple
- Safe !

Contact Information

Corporate Headquarters

- Purifics ES Inc.
  340 Sovereign Rd.
  London, Ontario N6M 1A8
  Canada
- 519.473.5788 (Voice)
  519.473.0934 (Fax)
  info@Purifics.com
  www.Purifics.com

Technical & Business Development Inquiries

- info@Purifics.com

Presentation Available for One Week Online

- http://www.purifics.com/login/index.html
- Select “Presentations”

  Username: **user1**

  Password: **pieprlup**

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Ogden Air Logistics Center

Characterization of Particulate Emissions from Missile Motor Detonation Activities

Date 4 May 2006

Mr. Glenn R. Palmer
Hill Air Force Base, UT
801-514-5380
Glenn.Palmer@Hill.af.mil

U.S. AIR FORCE

Innovation & Excellence

Co-Authors

- Michael J. McFarland — Utah State University, UT
- Steve L. Rasmussen — Hill Air Force Base, UT
- James A. Jensen — Bowen Collins and Assoc., Inc.
- Darren Lowe — CH2MHill,SLC, UT
- Mitchell H. Lindsay — CH2MHill, SLC, UT

Open Detonation Participants

- Utah Test and Training Range (UTTR)
- Naval Surface Warfare Center, Dahlgren, VA
- Hill Air Force Base, UT
- Utah Division of Air Quality (SLC, UT)
- CH2M-Hill, Inc. (Salt Lake City, UT)
- Bowen Collins and Associates, Inc. (Draper, UT)
- Utah State University (Logan, UT)

Outline

- Background
- Goal and Objectives
- Methodology
- Results
- Conclusions
- Recommendations

Background

- The Utah Test and Training Range (UTTR) is the only US location where energetic materials containing more than 10,000 lbs NEW can be detonated as a means of disposal.
- The forty (40) year mission of the TTU has included the treating of obsolete, surplus or unusable missile propellant, missile components, explosives and munitions.

Background

Background

- The maximum annual quantity of material permitted to be destroyed by open detonation is 6.55 million lbs NEW.

- As part of its mission, the Department of the Navy has requested the assistance of the TTU to dispose of Submarine Launched Ballistic Missile (SLBM) motors.

Background

- Air emissions for open detonation activities are categorized as fugitive emissions by the state of Utah air quality regulations.

- To date, open detonation is the only field validated means of demilitarizing large missile motors (e.g., greater than 10,000 lbs NEW).

Goal and Objectives

Goal:

- To qualitatively evaluate the particulate matter (PM) emissions associated with the open detonation (OD) of large missile motors.

Objectives:

- Design a viable sampling method for collection of PM data during OD.
- Evaluate the composition, size distribution, and fate of PM from OD activities.

Methodology

- **On September 13, 2005, the TTU conducted an open detonation of a 39,000 lb NEW class 1.1 Trident Stage 1 missile motor.**

- **Detonation of the missile motor was initiated by attaching a small C4 explosive (donor) charge, which is detonated by a timed fuse.**

Stage I Motor in Transit

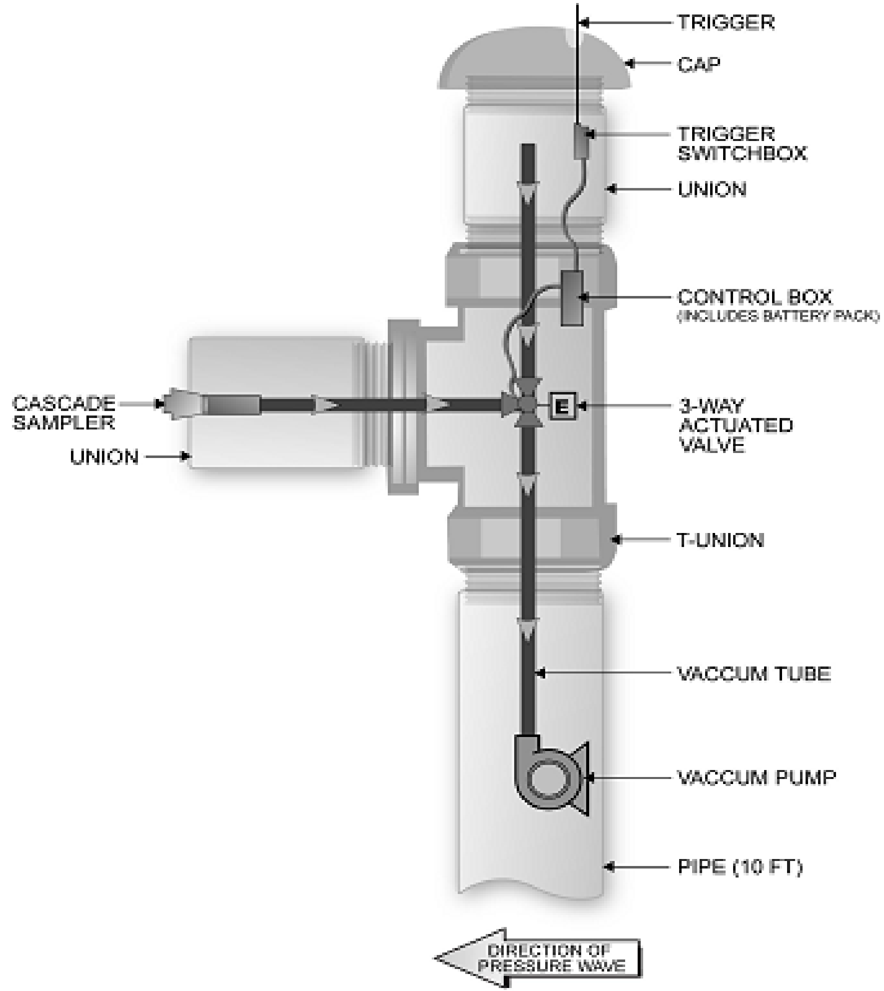
Unloading of Missile Motors

Methodology

- The sampling intake was positioned at a elevation of approximately 7 feet above ground level.

- A total of four (4) multi-stage Respicon^{TM} samplers were positioned at a 200 feet distance from the detonation event.

Methodology
Respicon™ Samplers



PIPING IS 4-INCH NPT BLACK STEEL PIPE

Respicon^{TM} Sampler

Methodology

- The Respicon™ samplers are cascade impactors utilizing filtering impingement media.

- Each impactor consisted of three different filters with the following cut sizes :

  1. < 2.5 μm
  2. 2.6 μm – 10 μm
  3. > 10 μm

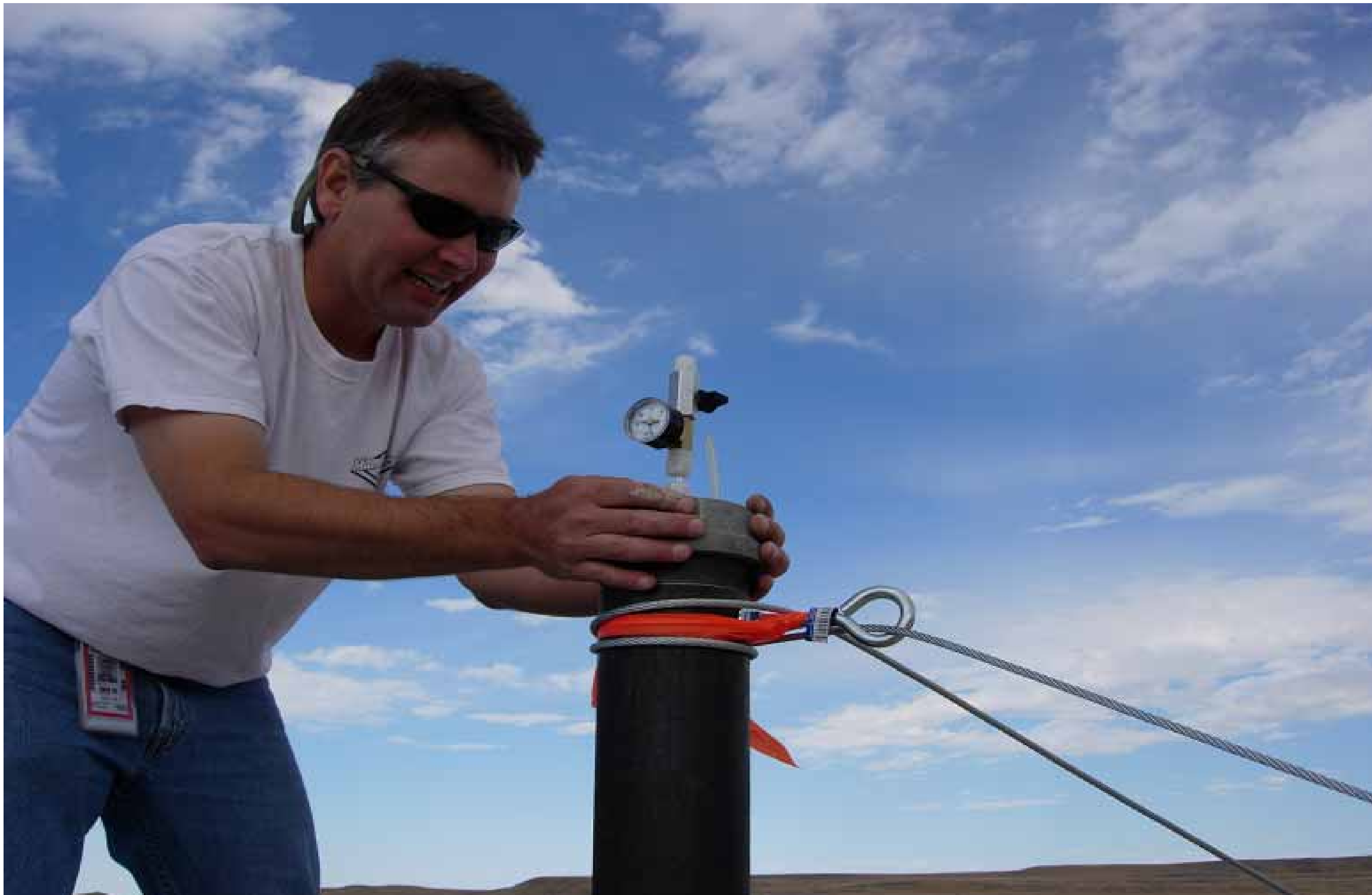
Methodology

- **The samplers were either fitted with Teflon™ or mixed cellulose ester (MCE) filters.**

- **Each PM sampling device consisted of a <u>3.11 liter per minute</u> air pump, an actuated three way valve and a multi-stage PM sampler (mechanically triggered)**

Elevated Air Sampler

Fitting of Pressure-Induced Sampling Device



Methodology

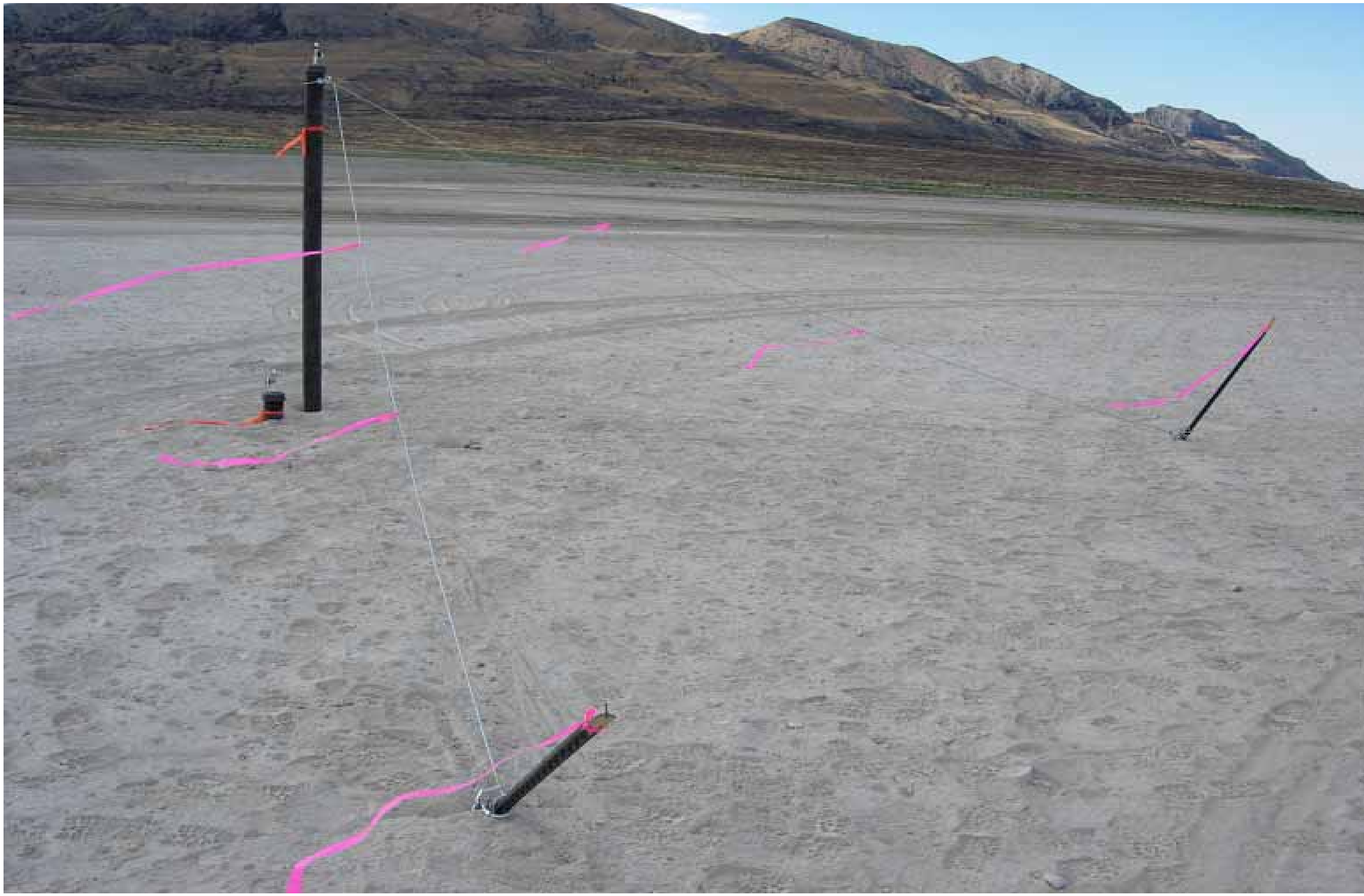
- The design approach was to use the detonation shock wave to trigger the device.

- The device directed air flow through the cascade impactor for preset time of 43 seconds.

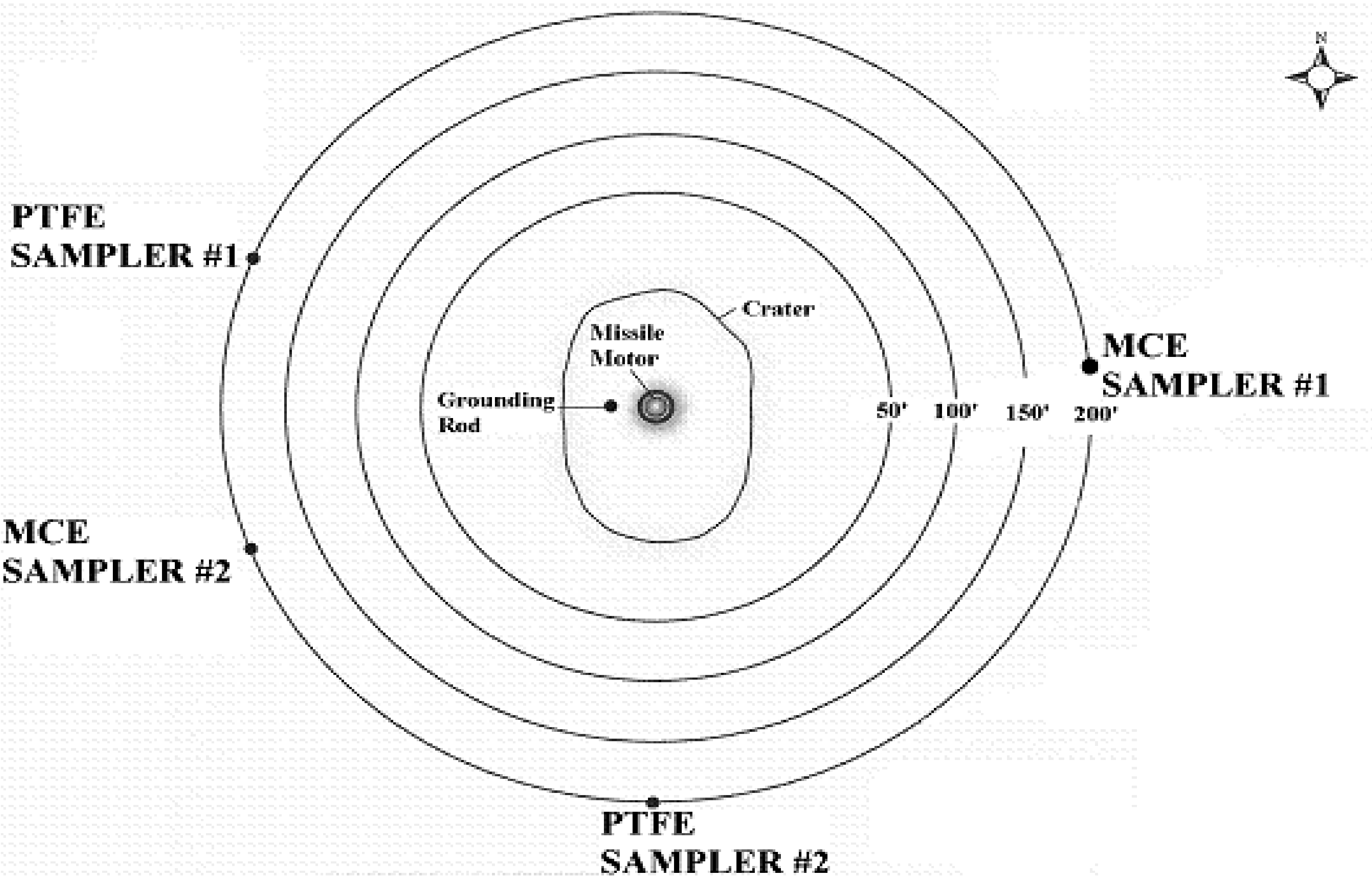
Methodology

- The air collection time was based on previous field collection activities and was found to ensure adequate collection of PM without dilution of sample.

Placing of Air Sampler



Sampler Layout



Size of Missile Motors

Methodology

- **Following the detonation, collected samples were analyzed for PM particle sizes using Electrozone™ technology and for elemental analysis using Scanning Electron Microscopy (SEM).**

Results

Results

- All samplers were recovered after the detonation event but two (2) had damaged sampling pumps.

- Air samples collected by the damaged samplers were not analyzed due to potential artifacts.

Results

Sample ID	Target Cut Size (μm)	Particle Size Distribution: Mean (μm)	Particle Size Distribution: Mode (μm)
Sampler 1 Filter 1	≤ 2.5	1.447	1.273
Sampler 1 Filter 2	2.6 to 10	1.552	1.276
Sampler 1 Filter 3	≥ 10	1.241	0.536
Sampler 2 Filter 1	≤ 2.5	1.189	0.532
Sampler 2 Filter 2	2.6 to 10	1.250	0.536
Sampler 2 Filter 3	≥ 10	1.105	0.532

Results

- The mean size of PM ranged from 1.105 to 1.552 μm.
- The mode ranged from 0.537 μm to 1.276 μm.
- These results suggests that the overwhelming majority of PM collected is fine (≤ 2.5 μm) .

Results

- On average, 92.2% of PM was found to be ≤ 2.5 μm while 99.9% was smaller than 10 μm (i.e., 7.7% of the PM was between 2.5 and 10 μm).

- Using the pump flow rate, sampling time and the $PM_{2.5}$ and PM_{10} cumulative percentages, the concentrations of PM at both sampling location could be estimated.

Results

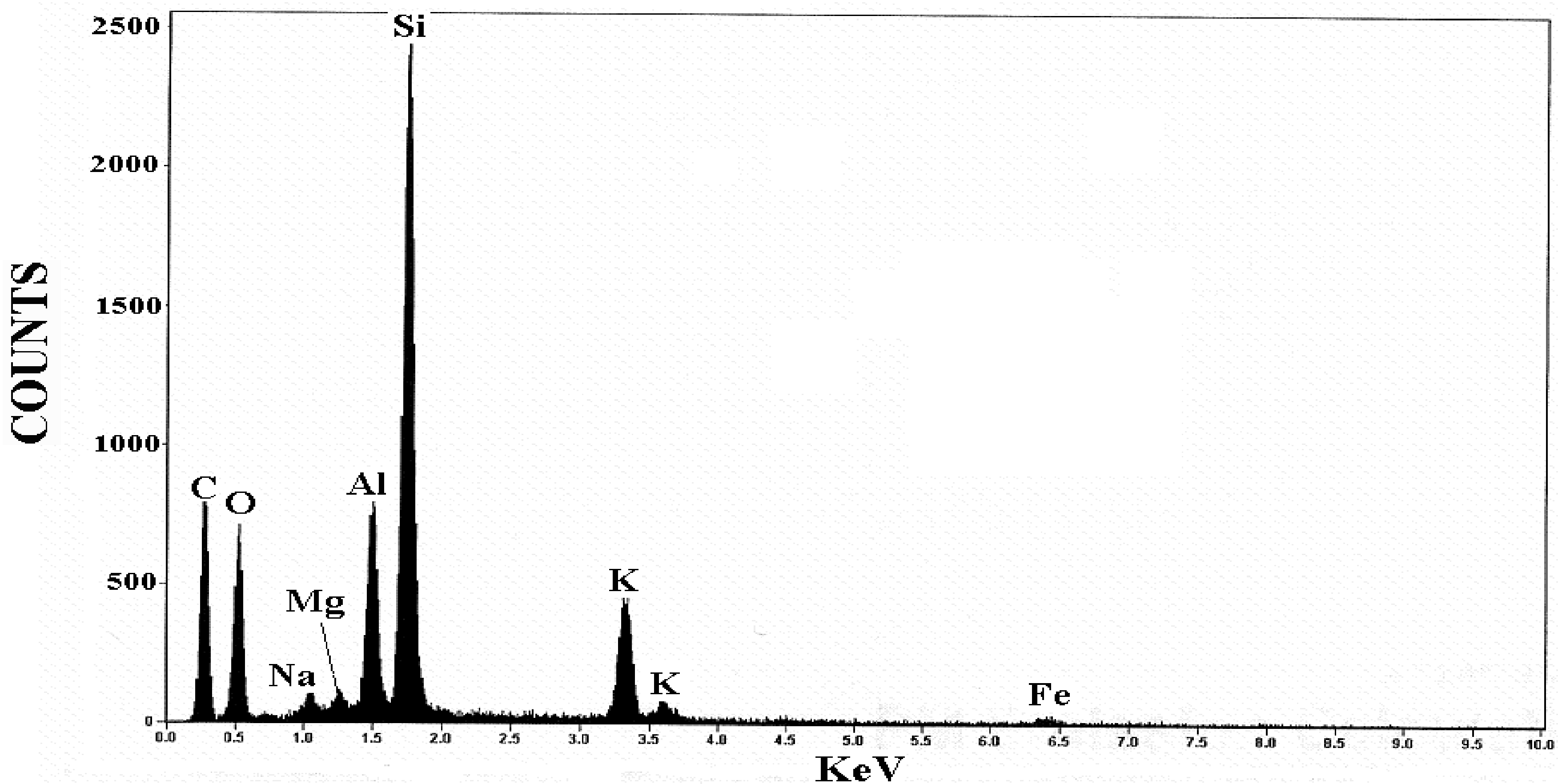
SAMPLER	PM Concentration (μg/liter)	
	$PM_{2.5}$	PM_{10}
Sampler 1	1068	5566
Sampler 2	414	1561

Results

- SEM results indicated that calcium, potassium, silicon, barium, aluminum and sulfur were the predominant chemical species associated with PM

- Chemical analysis indicated that the origin of particles may be native soils.

Results



SEM Spectrum of the Al/Si/K Particle on Sample 2, Filter 3

Results

- **The presence of soil minerals on the filters suggests that the Al_2O_3 generated by the detonation is likely <u>larger</u> than 10 μm.**
- **PM fine data collected is not uniformly distributed but was concentrated close to the source of the soil/ground.**

Conclusions

- The bulk of PM collected during the sampling event appears to originate from native soils.

- The environmental consequences of PM directly attributable to open detonation is minimal since both PM and transport distances are large.

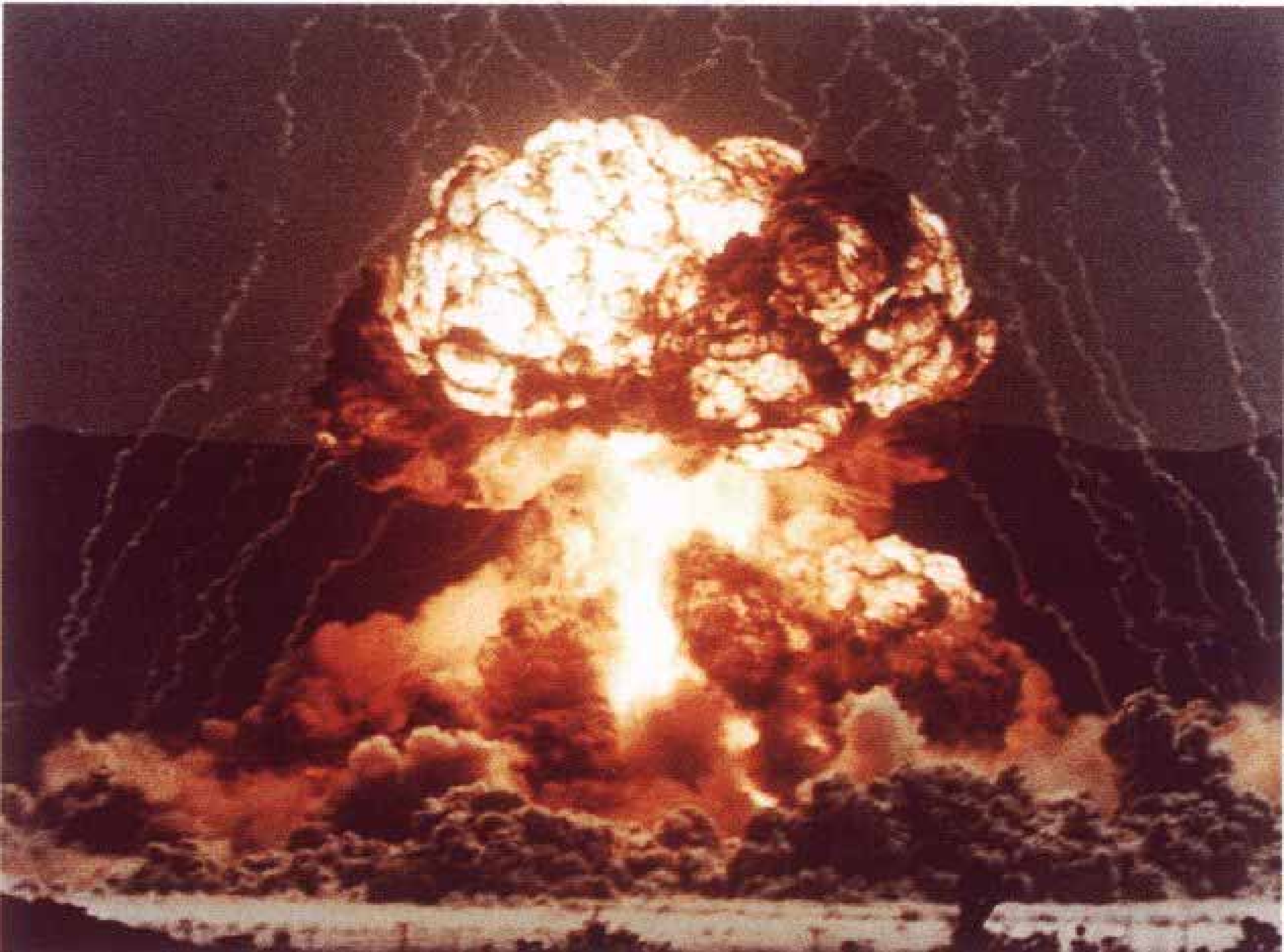
Recommendations

- Sample PM concentrations at elevations higher than 7 ft above ground level
- Extend the size determination for the alumina above 10 microns

Recommendations

- **Modify the sampling method to allow for the determination of emission factors for particulate from the propellant**

- **Determine the plume borne dispersion characteristics (e.g. settling velocities) for the propellant particulates**



UPDATE OF THE USEPA GUIDANCE DOCUMENT

Stacy Braye USEPA

NDIA DEMIL Conference

May 1-5, 2006

OPEN BURN/OPEN DETONATION PERMITTING

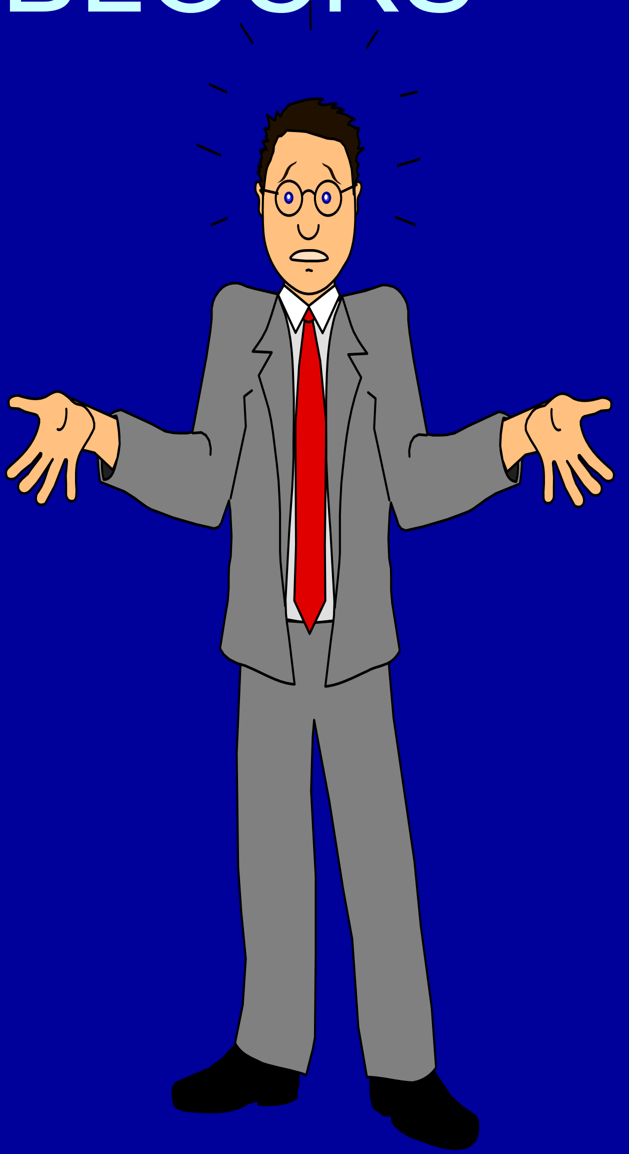
Status update on the guidance to permitting/closing OB/OD sites

THIS PRESENTATION WILL COVER:

- Permitting Roadblocks and Proposed Solutions
- Guidance Document Expected Contents.
- Partnering
- Application Development
- Permitting
- Guidance Development
- Proposals and Issues
- Comments on the Checklist
- Additional Issues

PERMITTING ROAD BLOCKS

- Multiple Regulators
- Inconsistent Permitting Requirements
- No Standardized Guidance or Expectations
- Getting Stakeholder Involvement



PROPOSED SOLUTION

- EPA workgroup
- Guidance Document and Checklist
- Web Based Guidance Kit

GUIDANCE DOCUMENT'S EXPECTED CONTENTS

- Overview of the process
- Checklist
- Guidance text
- Application
- Model permit language
- Special Appendices

GUIDANCE DOCUMENT PROCESS

THE GUIDANCE DOCUMENT WILL EXPAND ON REQUIREMENTS AS LISTED IN THE CHECKLIST

Strategy: Instead of creating the guidance all at once, we are planning to develop parts of it for approval among the states and regions.

TYPES OF UNITS

- Permitted Units
- Interim Status Units With Applications Submitted
- Interim Status Units That Are Closing On An Open Range
- Units That Are Wishing To Clean Close/ Certify Closure
- Units With Post Closure Permits
- There are no new units

CHECKLIST

We now have a final draft of the checklist to be used for aid in:

- Developing applications and
- Providing regulatory assistance and consistency on review of applications for completeness and technical review.

GUIDANCE DOCUMENT DEVELOPMENT

- This checklist will provide the backbone and structure for the guidance document.

- Each topic in the checklist will be expanded to include special details and other scientific references and guidances.

APPLICATION

PART A Contents Of Part A Of The Permit Application [40CFR270.13]

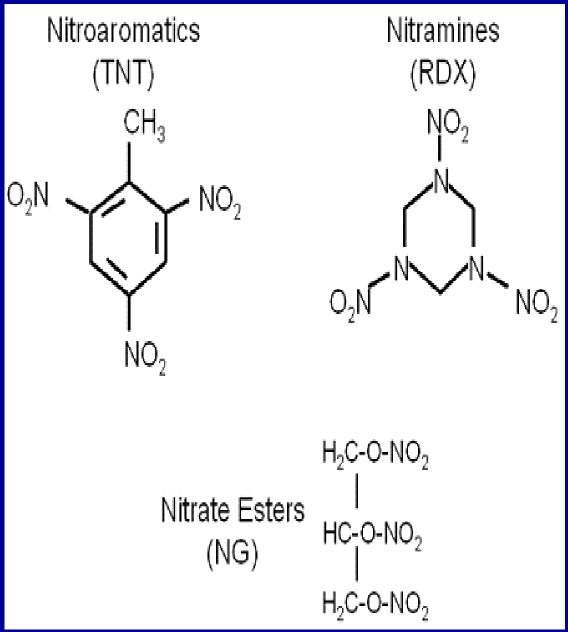
PART B Contents Of Part B Of The Permit Application [40CFR270.14(b)]

Section B	General Description
Section C	Waste Characteristics
Section D	Process Units
Section E	Procedures To Prevent Hazards
Section F	Inspection
Section G	Contingency Plan
Section H	Personnel Training
Section I	Corrective Action
Section J	Closure, Post Closure, Financial Assurance
Section K	Risk Evaluation

APPLICATION DEVELOPMENT

Parts of the guidance currently under development:

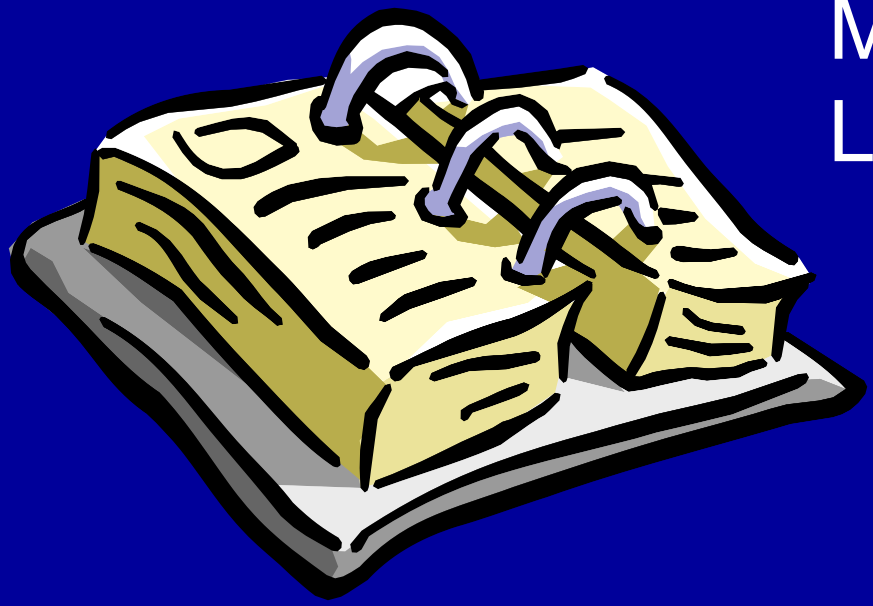
- Defining The Unit Boundary
- Characterization
- Air emissions factors



PERMIT DEVELOPMENT

CHECKLIST

COMPLETENESS AND TECHNICAL REVIEW



MODEL PERMIT LANGUAGE

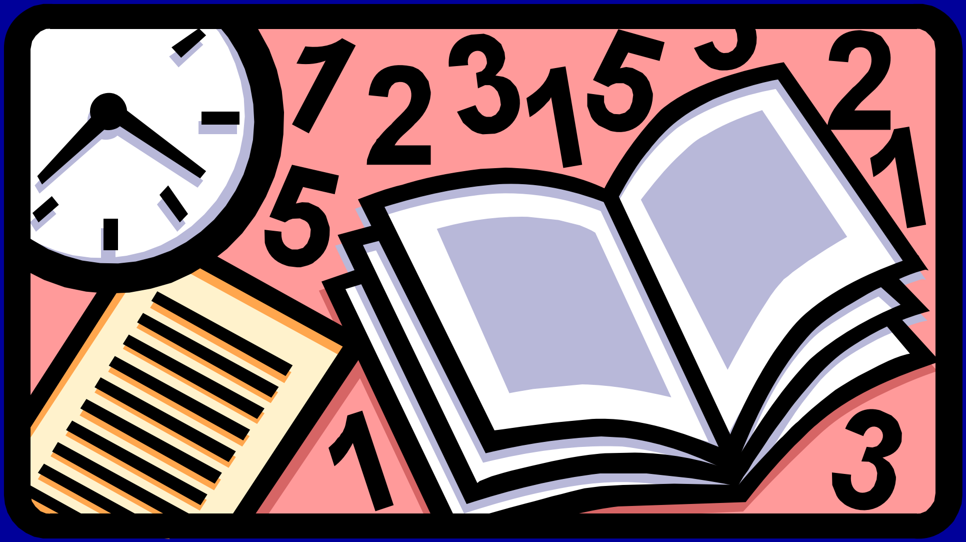
TO DEVELOP DRAFT PERMIT, INCORPOPRATING THE INFORMATION PROVIDED IN THE APPLICATION

SPECIAL PERMITTING REQUIREMENTS

- MONITORING FREQUENCY
- NOISE
- MET CONDITIONS
- REMEDIATION
- WAP
- CLOSURE/
- POST CLOSURE MONITORING

SPECIAL GUIDANCE APPENDICES

- Characterization
- Setting the Unit Boundary
- Monitoring and Testing



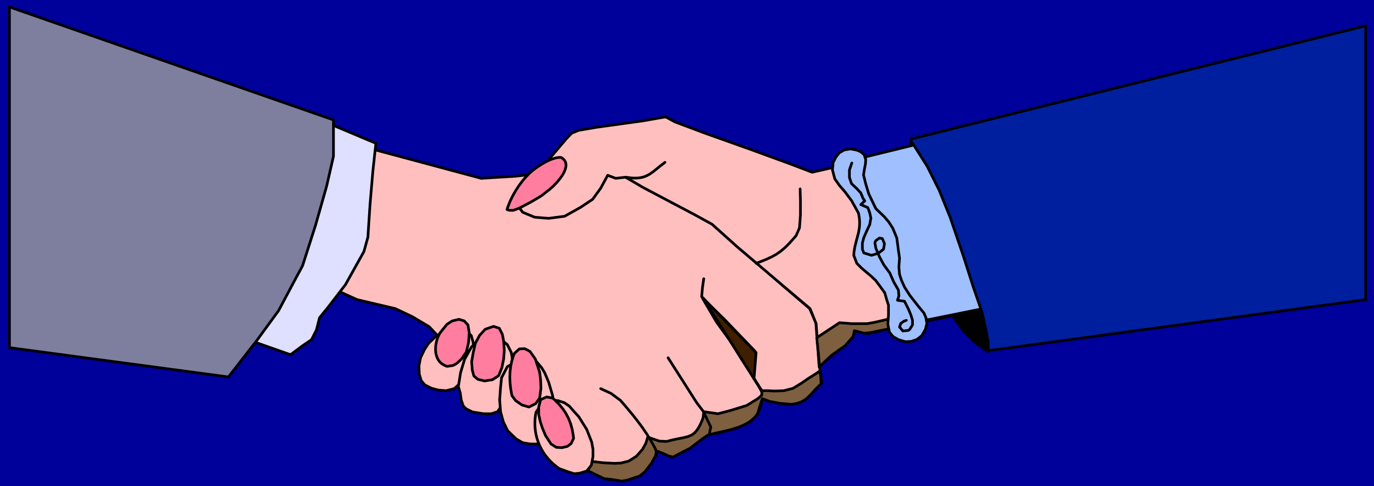
SPECIAL GUIDANCE APPENDICES

- DQOs/ QAPPs on testing results
- Risk assessment protocols
- Using air emissions factors for permitting

Note: air emissions factors must be OAQPS approved

PARTNERING

- Acceptable guidance cannot be developed in a vacuum
- We need your input



CHECKLIST REVIEW

- The checklist should NOT be cited or quoted at this point as it is a draft
- The checklist was sent out to DOD for review and comment

- If you do not have a copy of the checklist and you would like to participate in it’s development. Please e-mail me or sign up with me.

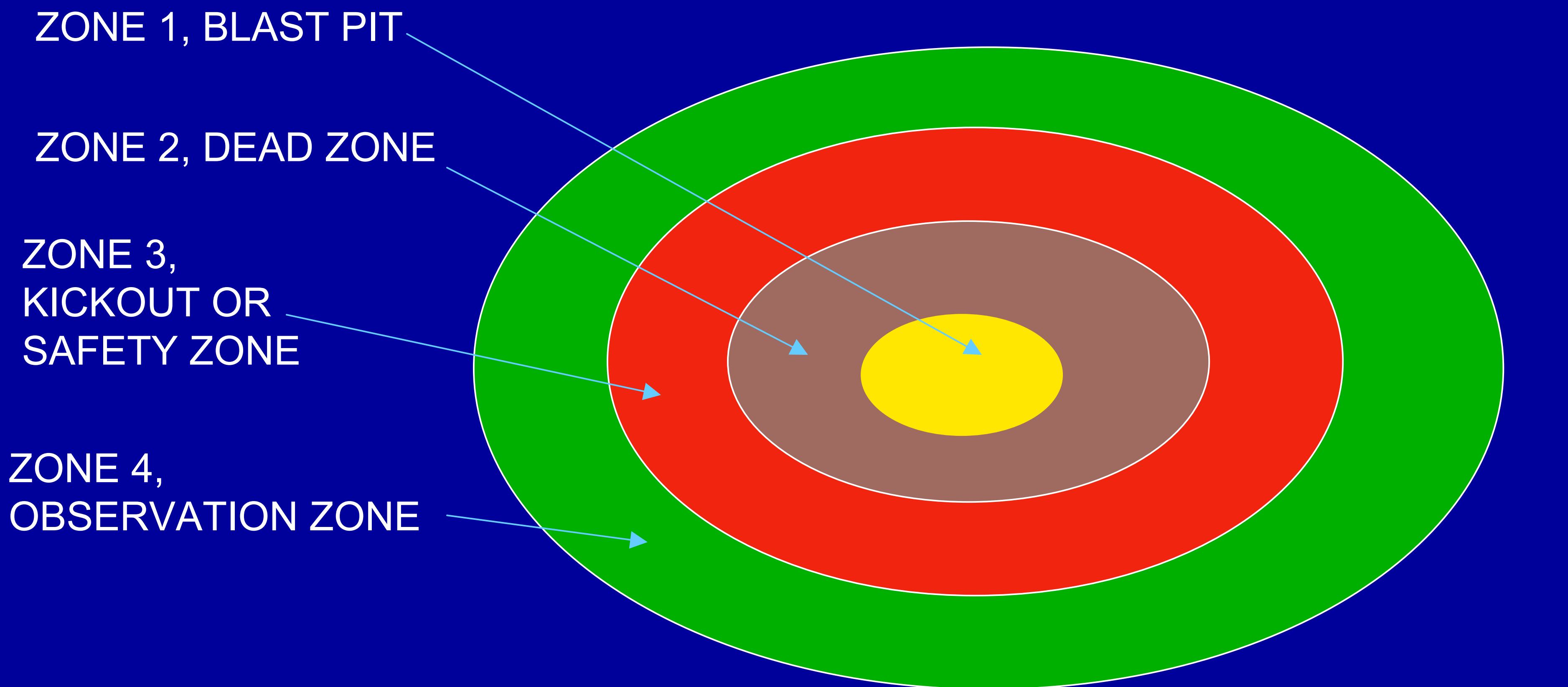
CHECKLIST
SOME COMMENTS

- Unit Boundary setting
- Developing air emissions factors methodology
- Characterization
- Monitoring
- Remediation
- DQOs, SAP, QAPP

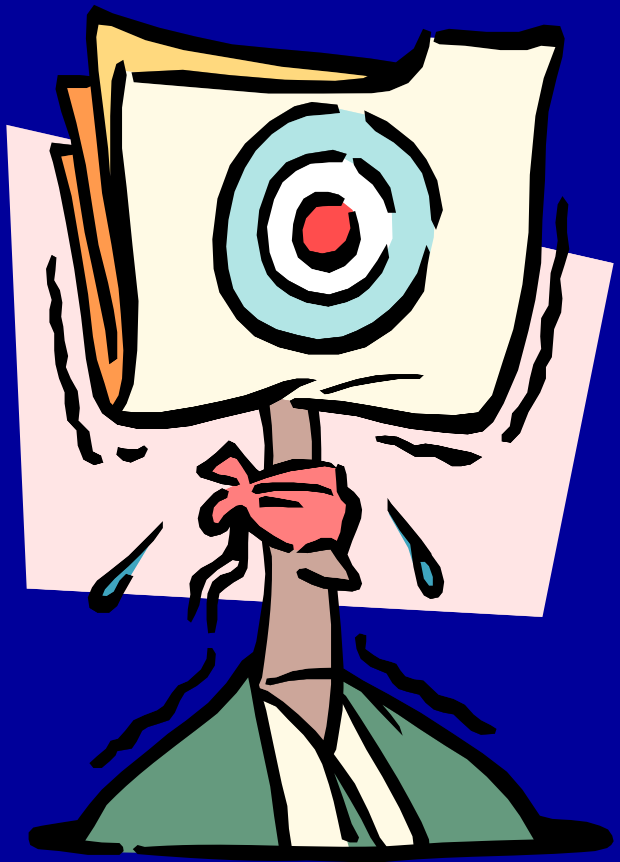
- Information for these comments taken from EPA, DOD and DOD guidance documents.

UNIT BOUNDARY SETTING

- Setting zone
- Low order/high order detonation



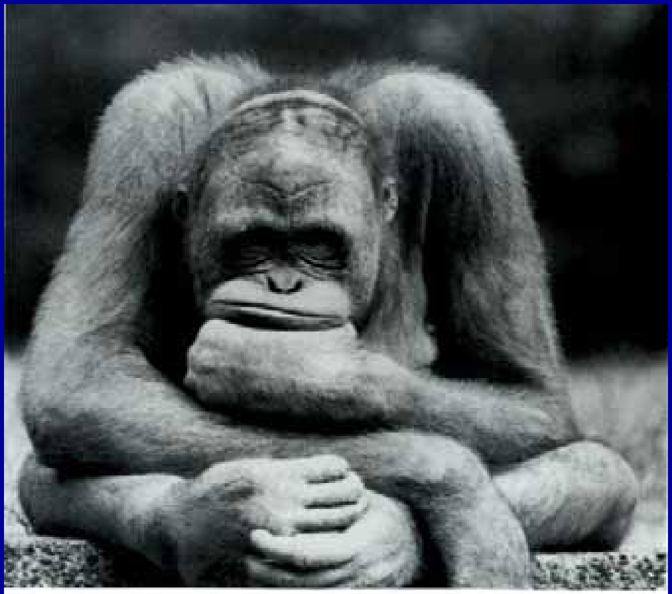
DEVELOPING AIR EMISSIONS FACTORS METHODOLOGY



- Air emission factors by particulate deposition studies
- Realistic scaled down tests
- Representative sample
- Data quality issues

CHARACTERIZATION

- Sampling difficulties based on random deposition of contaminants
- Guidance differences in requirements for sampling plans
- Inventory problems
- List of constituents to sample for (degradation products and chemical reaction products)
- Sampling pattern



唉，该怎么办，到底该怎么办呢？

Oh what to do, what to dooo?

MONITORING

- Frequency
- Well location
- Sampling and Analysis Plans
- Cleanup action limits
- Noise

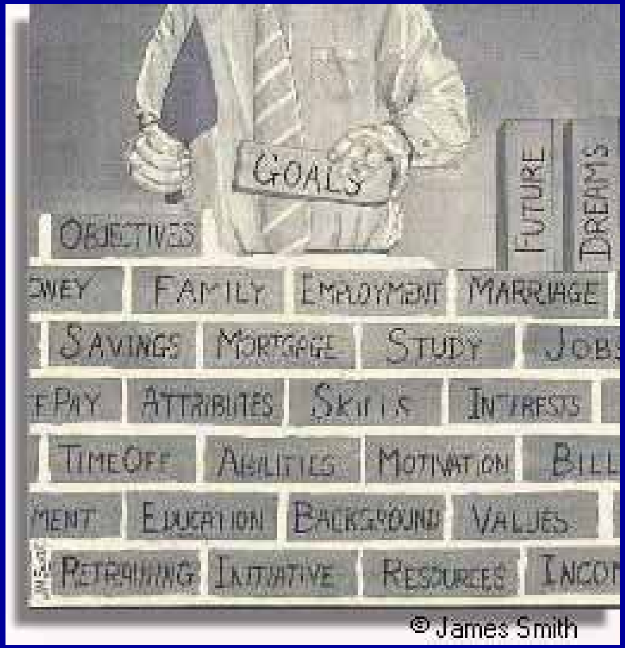
REMEDIATION

- Based on an action level?
- Based on a risk based level?
- Based on number of pounds of munitions detonated?

NOTE:
Change in checklist on Remediation

DQOs, SAP AND QAPP

- Data Quality Objectives (DQOs) are critical for data quality, number of samples and project completeness goals.



- Sampling and Analysis Planning (SAP) is critical for identifying the best sample locations that represent area characterization.
- The Quality Assurance Project Plan (QAPP) defines lab capabilities, accuracy and precision.

COMMENTS

EPA invites comments and suggestions by the end of July and hopes to finalize before the end of the year.

In the mean time we will continue to work with you on developing more of the contents of the guidance.

Stacy Braye
75 Hawthorne WST-4
San Francisco, CA 94105
415-972-3345
Braye.Stacy@epa.gov

- Subpart X website, home of the future toolkit.
  http://www.epa.gov/oswer/hazwaste/permit/subpartx.htm

- Region 4 guidance for Subpart X units
  http://www.epa.gov/region4/sesd/eisoqam/eisoqam.pdf

- EPA Compendium of EPA policy/clarification letters
  http://www.epa.gov/RCRAonline

PIKA International, Inc.

Cleanup of White Phosphorus Warehouse Fire and Demilitarization of M825 WP Canisters

Pine Bluff Arsenal, Arkansas

Presented by: Richard Holthouser, Site Manager
Shahrukh Kanga, Program Manager

4 May 2006

Introduction

PIKA

Pine Bluff Arsenal

- Colored Smoke Mix
- White Phosphorus (WP)
- Red Phosphorus (RP)
- Riot Control
- HC/TA Smoke Mix
- Incendiary Mix
- Smoke Pots
- Pyrotechnic Mix
- Conventional Munitions

…one of the few Army sites at which WP-filled weapons are loaded

Fire at White Phosphorus Warehouse

PIKA

Arkansas Democrat Gazette
NORTHWEST ARKANSAS EDITION

Fire at PB Arsenal destroys warehouse

ARKANSAS DEMOCRAT-GAZETTE

A fire at the Pine Bluff Arsenal early Monday morning destroyed a warehouse that stored about 7,500 containers of a white phosphorous compound used in conventional weapons, officials said Monday.

Security guards reported the fire shortly after midnight and firefighters had the blaze under control by 1 a.m.

CANISTERS FOCUS OF FIRE PROBE

By Wilson Brown/OF THE COMMERCIAL STAFF
Thursday, June 16, 2005 10:04 AM CDT

The Pine Bluff Arsenal has finished water and air tests following a fire June 6 that destroyed a warehouse containing white phosphorus.

...s into the cause of the fire that

BLAZE BLAMED ON LEAK

By Wilson Brown/OF THE COMMERCIAL STAFF
Friday, June 24, 2005 10:01 AM CDT

WHITE HALL -- A leaking canister of white phosphorus caused the June 6 warehouse fire at the Pine Bluff Arsenal, an Arsena...

"The fire originated in the east end of th... being exposed to oxygen in the atmosp... in a written statement.

ARSENAL BATTLES THE HEAT

By Wilson Brown/OF THE COMMERCIAL STAFF
Friday, June 10, 2005 10:17 PM CDT

Crews used light sprays of water Friday to cool debris from a white phosphorus fire ... the Pine Bluff Arsenal in an effort to keep the flammable product from reigniting.

Meanwhile, officials confirmed that about 50 Arsenal workers were moved when flar... and thick white smoke suddenly erupted Thursday and that two deputy sheriffs suffe... skin irritations during the original fire Monday.

Use of shower-like misters was a change in strategy as the Arsenal deals with the ... of Monday's 17-hour fire that destroyed a warehouse and 7,500 canisters of white phosphorus.

CLEANUP BEGINS – ARSENAL: FIRE SITE WORK TO BE COMPLETE BY JANUARY

By Wilson Brown/OF THE COMMERCIAL STAFF
Thursday, September 22, 2005 10:29 AM CDT

Cleanup at the site of a warehouse fire at the Pine Bluff Arsenal began this week and could end by mid-January, Arsenal officials said Wednesday.

The Arsenal recently awarded a $2.3 million contract to PIKA International of Houston for the work, said Charlie Neel, the Arsenal's chief of environmental compliance.

About 30 percent of the cleanup work will be spent locally, especially asbestos removal, Neel said, with PIKA hiring out some of the work to local companies.

The June 6 fire destroyed a vintage warehouse on the south side of the Arsenal near the Arkansas River.

The fire also destroyed thousands of canisters of white phosphorus being stored in the warehouse.

Project Objective

PIKA

Time-Critical Cleanup, Transportation and Disposal of M825 WP Canisters and Hazardous Wastes/Burn Rubble

Identical PBA Warehouse

Aerial View of the Burnt WP Warehouse

Project Challenges

PIKA

- Safety - Detonated/intact canisters with crusted WP
- Collapsed transite roof – mixed wastes
- WP migrated inside porous debris – transite and blocks
- 24/7 sprinklers to contain smoke/flash fires
- Asbestos certification for UXO personnel
- TCRA under Interim RCRA Part-B Permit

Cleanup and Demil of WP Canisters

PIKA

Task 1 - Work Plans and Regulatory Approvals

- Hazard Analysis
- PBA Safety & Industrial Hygiene
- PBA WP Production
- Arkansas DEQ (Asbestos)
- 40-hrs Asbestos Worker Training
- PPE Selection
- Interim RCRA Part-B Permit
- PE Approval of Cutting System
- Mixed Waste Profile Approvals
- Community Relations

Cleanup and Demil of WP Canisters

PIKA

Task 2 – Design-Build of M825 Canister Demil Equipment

Intact

Deformed

Rear Plate

Steel Tube

WP Wool/Felts

Aluminum Rib

Burster Well

Front Plate

DEMIL

WP Dispose

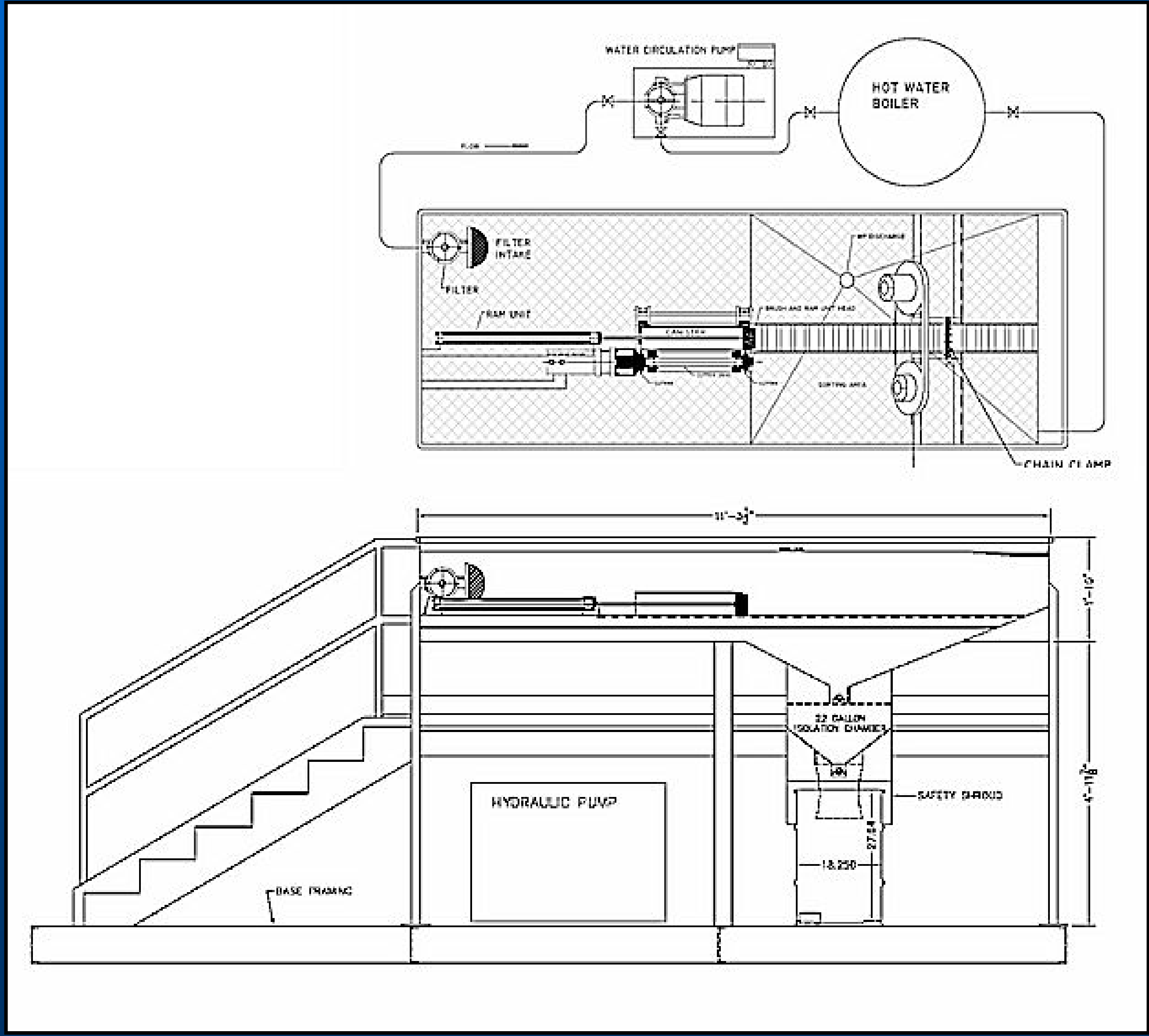
Metal Recycle

Cleanup and Demil of WP Canisters

PIKA

Components

- Cutting Station
- Intact vs. Deformed
- Hydraulic Ram
- Hot Water Boiler
- Loading Hopper
- Splash Protection
- Control Panel
- Recycle Water



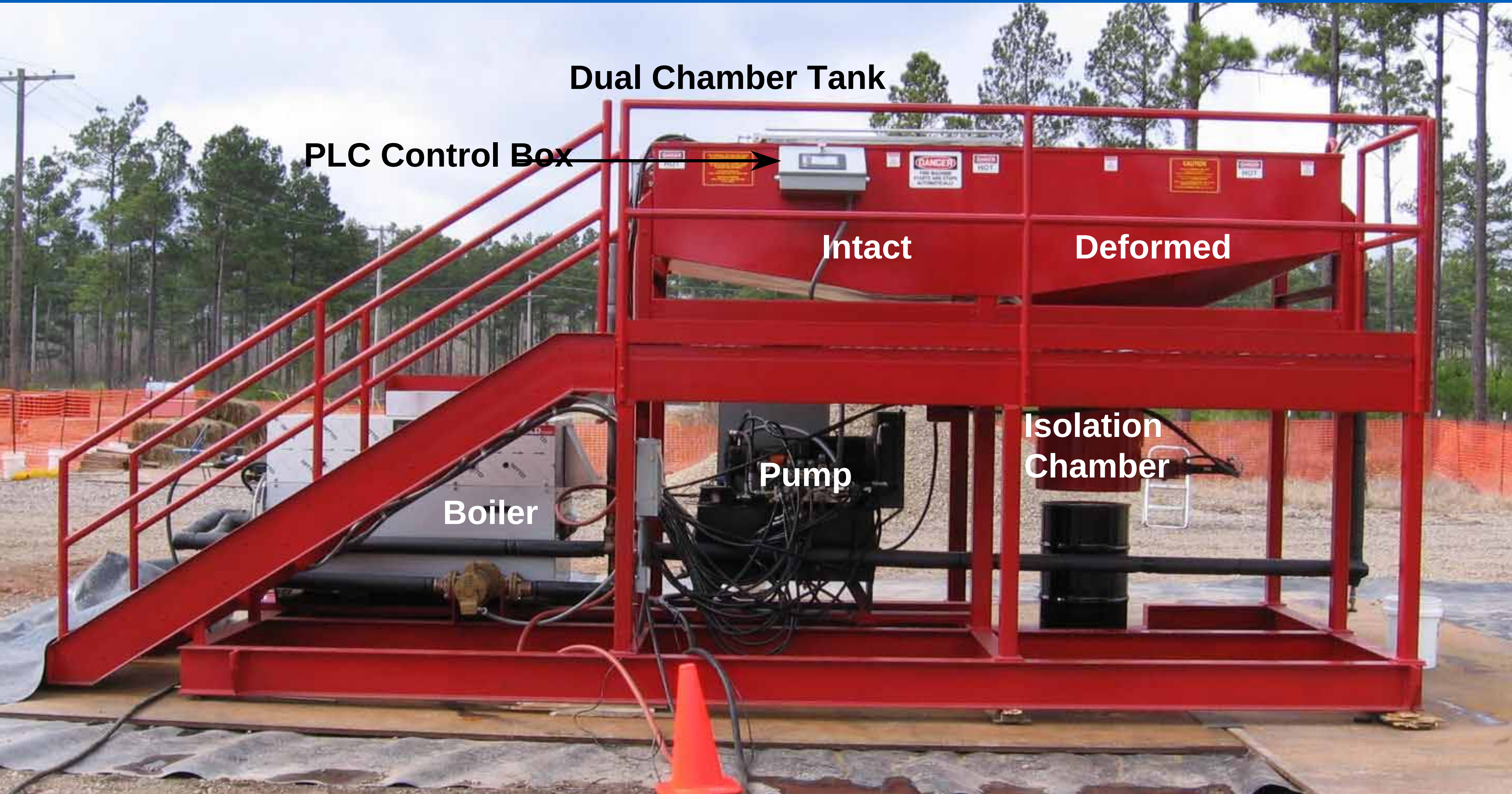
Cleanup and Demil of WP Canisters

PIKA

Cleanup and Demil of WP Canisters

PIKA

WP Canister Demil Station



Cleanup of WP Warehouse Fire

PIKA

Task 3 - Removal of WP & Transite Outside Bldg. Footprint

Task 4 - Removal of Large Metal Debris from Burn Rubble

Cleanup of WP Warehouse Fire

Task 5 – Recovery and Segregation of WP Canisters

Cleanup of WP Warehouse Fire

PIKA

Task 6 – Segregation of Asbestos Debris (transite roof)

Cleanup of WP Warehouse Fire

PIKA

Task 7 – Packing of WP Contaminated C&D Debris

Flash → Landfill

Flash → Solidify → Landfill

Demil of WP Canisters

PIKA

Task 8 – Demilitarization of WP Canisters

Demil of WP Canisters

PIKA

Video - Operation of the Canister Demil Station

- Demil of M825 WP Canisters performed under water

- Due to safety limitations, the demo video shows cutting of inert canister in fabrication shop

Cleanup of WP Warehouse Fire

PIKA

Task 9 – Removal of Concrete Pad and WP Beneath Pad

Cleanup of WP Warehouse Fire

PIKA

Video – Removal of WP Migrated Beneath Pad

Cleanup and Demil of WP Canisters

PIKA

Task 10 – Transportation and Disposal

700,000 lbs of WP wastes shipped to offsite incinerator

Demil of WP Canisters

PIKA

Improvements to Enhance Safety & Production

- Upgrade Hopper Dump Valve
- Thermal Tape on Isolation Chamber
- Delayed Startup - Standoff Distance
- Hardening of Cutting Bath
- Increase Bath Temperatures

Cleanup and Demil of WP Canisters

PIKA

Site Cleanup Completed on 27 April 2006

Waste Shipments to be completed 12 May 2006

Fire cleanup to be completed this month

Courtesy of the Directorate of Risk Management and Regulatory Affairs

Cleanup efforts at the site of a World War II-vintage warehouse that burned at Pine Bluff Arsenal last June are expected to be completed in April.

Arsenal officials awarded a $2.3 million dollar contract to PIKA International of Houston, Texas to do the cleanup work last October, according to Charlie Neel, chief of environmental compliance for the Directorate of Risk Management and Regulatory Affairs.

The fire, which was discovered through a routine security check, occurred in the early morning hours last year in a warehouse storing canisters of white phosphorus.

White phosphorus or WP is a white or pale yellow, translucent waxy chemical solid used in ammunition by the military for dense white smoke screenings or signals. In the presence of oxygen, WP spontaneously ignites. The Arsenal is the Army's sole producer of WP ammunition in the Western Hemisphere.

The original estimated completion of the clean-up effort was January. During these efforts PIKA has re-evaluated site operations, assessed new hazards associated with clean-up and debris removal efforts, and re-established the requisite controls needed to ensure the safety and health of site personnel, the environment and the public. The establishment of these new procedures has also required modification and approval of the site work and safety plans, along with additional hazard information training for site personnel.

To assist the Arsenal with future demilitarization of canisters filled with white phosphorous, PIKA has also designed, manufactured and tested a unique canister processing unit. This equipment is currently being used by PIKA to cut existing canisters underwater for safe shipment and disposal. This system may also be used at a future date to remove the WP from the metal canisters, thereby reducing both the hazards to the workers as well as the cost of waste disposal.

Funding for the project was provided by the Joint Munitions Command (JMC) at the Rock Island Arsenal, Illinois.

Once debris is removed from the site it will be segregated into different types. "If it is metals or ash it will go to the Jefferson County landfill because it is solid waste," said Neel, in an October article in the *Arsenal Sentinel*. "Anything that is contaminated with hazardous waste will go to Von Roll Waste Technologies Industries at East Liverpool, Ohio."

Arsenal and fire investigators determined that a leaking WP canister caused the fire. According to the final investigation report, the WP leaked from the canister through a pinhole caused by oxidation. Heat generated by the exposed WP heated the nearby canisters, igniting the roof framing, and causing total loss of the structure.

There are no immediate plans to rebuild the warehouse.

Workers with PIKA International clean what remains of a World War II-vintage warehouse that burned June 2005. The warehouse stored white phosphorus (WP) containers. Cleanup should be completed this month, according to the Directorate for Risk Management and Regulatory Affairs. (U.S. Army file photo)

Passed State RCRA Inspection on 3 May 2006

Cleanup and Demil of WP Canisters

PIKA

- Cutting Station - used to Demil 11,000 WP Canisters in CY 2006
- **Key Features:**
  - All Operations Performed Underwater
  - Splash Protection Using Lexan
  - Delayed Startup Provides Safety Standoff Distance
  - Bath Hardened for Pressurized Canister
  - Heated Bath and Isolation Chamber Keeps WP Mobile
  - Cost Savings by Reducing Disposal Quantities
  - Cost Recovery from Metal Recycling

PIKA
INTERNATIONAL, INC.

THANK YOU FOR ATTENDNG OUR TECHNICAL session

QUESTIONS?

Presented by: Richard Holthouser, Site Manager
Shahrukh Kanga, Program Manager

4 May 2006

Induction Heating of Munitions

Dan Burch, Mike Johnson NSWC Crane

Chris Dilorenzo DAC

2006 Global Demilitarization Symposium & Exhibition

May 4, 2006

Indianapolis, Indiana

Induction Heating of Munitions

- Program Proposed by El Dorado Engineering under NSWC Crane Broad Agency Announcement N00164-04-R-4711
  - Demilitarization By Inductive Heating Meltout (DIHME):
    - Technology Integration:
      - Abrasive Waterjet Cutting
      - Robotics/Materials Handling
      - Induction Heating
      - Initially Designed for Demilitarization of 60-mm Mortars

Demilitarization By Inductive Heating Meltout (DIHME)

- AWJ:
  - Based on Work Performed at NSWC Crane and University of Missouri-Rolla (UMR)
- Robotics/Materials Handling:
  - Based on Work Performed by EDE and Ajax-Tocco Magnathermic (ATM)
- Induction Heating:
  - Based on Work Performed at NSWC Crane DTF and ATM experience

ABRASIVE WATERJET CUTTING

NSWC Crane

- **Tested AWJ vs. ASJ Waterjet Systems**
  - **Downselected to Conventional AWJ System**
    - 40-mm HE/HEI Projectiles
    - 60-mm Mortars
    - 81-mm Mortars
    - 105-mm Projectiles
  - **Test Matrix**
    - Water/Abrasive Flow Rate
    - Nozzle/Water Orifice Type
    - Rotational Speed
    - Nozzle Stand-off Distance
    - Cutting Angle
    - Cutting Site

500-Lb Test Cell

AWJ System

AWJ RESULTS SUMMARY

Item	Cutting Zone Wall Thickness	Cutting Time	Cost Per Shell
40-mm HE/HEI	0.18" (Fuze)	21 sec	
	0.25" (Tracer)	30 sec	$1.02
60-mm Mortar	0.135" (Fin)	13 sec	
	0.265" (Fuze)	32 sec	$1.75
81-mm Mortar	0.243" (Fin)	23 sec	
	0.345" (Fuze)	55 sec	$2.73

ABRASIVE WATERJET CUTTING

NSWC Crane

- **FY 06/07 Effort**:
  - Abrasive Cutting and Washout of 105-mm Projectiles (1,019 rounds)
    - Testing ROCTEC 100 Diamond Coated Nozzle
    - Period of Performance – Feb 2006 – Apr 2007

Severed 105-mm Projectiles

ABRASIVE WATERJET CUTTING

University of Missouri-Rolla

- **Previous Effort**
  - Completed Evaluation of Commercially Available AWJ nozzles
  - Completed Cutting Parameter Optimization Testing (40-mm Proj.)
  - Completed ASJ Optimization/Testing
  - Completed Abrasive Recycle Study
  - Completed Full-scale System Design
    - Cut Detection Method
    - Multi-unit Holding and Rotation Fixture

Cut Sensor Testing

Holding and Rotation Fixture

ABRASIVE WATERJET CUTTING

University of Missouri-Rolla

- **FY 06 Effort:**
  - 60-mm Mortar Cut Parameter Testing
  - HP Pump System Procurement
  - System Integration Testing
- **FY 07 Effort**
  - Nozzle Optimization
  - Abrasive Recycling

Nozzle Optimization Testing

Abrasive Material Testing

Induction Heating

- **Previous Work**
  - Design item specific Heating Coil
    - Produce Temperature of 275-300°F inside Shell in 10 Seconds
  - Provide Power Supply/Cooling System
    - 5kW Unit used for 40-mm and 60-mm Rounds
    - 20kW unit used for 81-mm, Proposed for 105-mm Projectiles

Test Setup in 1 LB Test Cell

Induction Heating Results Summary

Item	Meltout Heating Cycle Time/Power	Meltout Time	TNT Removed	Decon Heating Cycle Time/Power	Removal Efficiency
40-mm w/band	12 sec @ 70% Power (3.5 kW)	22.9 sec	99.3%	25 sec @ 5 kW	99.99995%
40-mm w/o band	4 sec @ 100% Power (5 kW)	5.0 sec	99.6%	15 sec @ 5 kW	99.99995%
60-mm	10 sec @ 80% Power (4 kW)	11.9 sec	99.1%	20 sec @ 5 kW	99.9997%
81-mm	10 sec @ 45% Power (9 kW)	9.4 sec	99.9%	30 sec @ 9 kW	99.9999%
				40 sec @ 9 kW	99.99999%

Induction Heating

- **Current Effort**:
  - 105-mm Projectile Meltout (79 rounds)
  - Awaiting ESO Approval to Conduct Demil Operations in 50-LB Test Cell

105-mm Projectile Induction Heating Coil

DIHME Program

NSWC Crane/EDE/ATM/UMR/SMS

- **Phase I:**
  - **AWJ/IH Integrated System (60-mm)**
  - **Two Phase Project (28 Months)**
  - **Period of Performance – 14 Months**
    - Preliminary Design Diagram
    - Final Design Diagram
    - Equipment Development
    - Live Demonstration
    - Safety and Hazards Analysis

60-mm Mortar Bodies and Reclaimed Comp B

DIHME Program

Phase I

- **Preliminary Design Diagram**:
  - Equipment Layout Diagram to Include:
    - 4-Station Coil for Explosive Meltout
    - Robotics/Loading Equipment
    - Material Handling for removal of explosives/Empty Casings
    - Equipment Interface/Function Document
- **Final Design Diagram**:
  - Component Feeding/Unloading Mechanisms
  - Munition Transfer Devices
  - Robotic end effectors
  - Sensor Orientation

Reclaimed TNT from 40-mm Projectiles

DIHME Program

Phase I

- **Equipment Development**:
  - **Induction Heating Coil Development**
  - **Multi-Coil Design/Fabrication**
    - 4-Station Unit
    - Includes temperature sensors and weight sensors
  - **Materials Handling Development**
    - Munition Transport Station from AWJ to Robot
    - Empty Casing/Explosive Transport Station
  - **Inert Production Simulation**
    - Robotic Load/Unload Station
    - Four-unit Induction Heating Station

Severed 81-mm Mortar

DIHME Program

Phase I

- **Live Demonstration**:
  - Duplicate Inert Testing Using M49A43 60-mm Mortar
  - Includes Installation of Empty Casing/Explosive Transport Station
- **Safety and Hazards Analysis**
  - HA Performed by Safety Management Services

DTF 50-Lb Test Cell

DIHME Program

Phase II

- **Phase II Tasks: (14 Months)**
  - Preliminary Plant Design
  - Final Plant Design
  - System Component Integration (AWJ)
  - Materials Handling
  - Shipping/Installation/Training
  - Operational Demonstration

Coil Designs

DIHME Program

Phase II

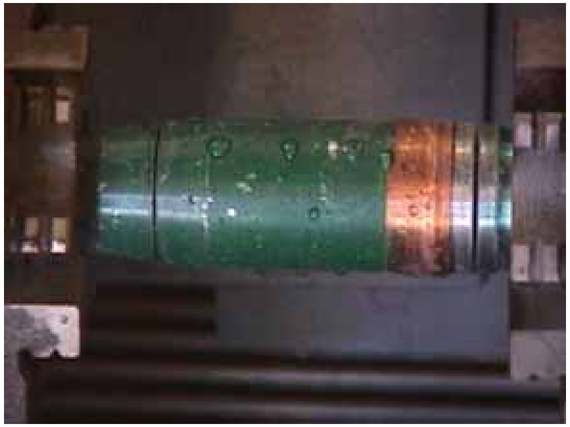
- **Preliminary Plant Design**:
  - Processing Equipment
  - Materials Handling Equipment
  - Support Equipment
  - Plant Support Requirements

Melted out TNT from 81-MM Mortar

DIHME Program

Phase II

- **Final Plant Design**:
  - Completed after Site Location is Determined
  - Acquire Safety Approval for Plant Layout
  - Material Handling Size Requirements
    - Conveyor Length
    - Power Requirements
    - Building Modifications



40-mm Projectile after Cutting Operation

DIHME Program

Phase II

- **System Component Integration**:
  - Integration of UMR Developed AWJ System with IH/Robotics
  - PLC Integration
  - Central Communications Software Integration

Induction Heating 5kW Power Supply Unit

DIHME Program

Phase II

- **Material Handling System**:
  - Munitions Tray (Mortar orientation, interface with robot)
  - Roller Conveyors
  - Indexing Conveyor
  - Transfer Mechanism (transfer energetics/mortar bodies to discharge conveyor)

DIHME Program

Phase II

- **Shipping/Installation/Training**
- **Operational Demonstration**:
  - Initial Inert Demonstration
  - Follow-on Live Testing
  - System Modification
  - Provide Training/Operations/Maintenance Manuals

Decontamination of Test Range Metal Debris using a Transportable Flashing Furnace

Ralph W. Hayes
El Dorado Engineering, Inc.

May 2006

TECHNICAL OBJECTIVES

- Demonstrate the Transportable Flashing Furnace (TFF) can support range cleanup in an effective, efficient and economical manner
- Provide new burn basket design for processing a variety of range scrap configurations and materials (including aluminum)
- Establish TFF required processing time and operating costs

TECHNICAL OBJECTIVES

Range Scrap Processing

- Metal potentially contaminated with explosives is known as “3X”
- Explosive contaminated metals are controlled within DOD and cannot be freely sold or disposed of (TB-700-4)
- Heating explosive contaminated metal parts assures the metal is free of contamination - “5X”
- EDE proposed that a Transportable Flashing Furnace can be used to accomplish this work

TECHNICAL APPROACH

EDE has developed a simple transportable flashing furnace based on the Army's Contaminated Waste Processor technology but targeted only to explosive contaminated metal parts.

TECHNICAL APPROACH

- HARDWARE DESIGN CRITERIA FOR TREATING 3X METALS TO 5X
  - Handle 10,000 lbs non-combustible explosive contaminated 3X metal (flash to 5X)
  - Totally contained on 48 ft trailer
  - Fuel oil fired dual burner with propane pilots
  - Standard operating temperature: 1400-1600°F
  - Unfired afterburner to minimize emissions
  - Cooling air for rapid cool down

TECHNICAL APPROACH

- NO PERMITS REQUIRED
  - Emissions below *de minimis* levels that require an air permit
  - Non RCRA material

Must be verified for each State of interest

TECHNICAL APPROACH

- Site Selection Eglin Air Force Base
- TFF Available
- Wide Varieties of Range Scrap
- Potential Benefit to Eglin

TECHNICAL APROACH

Test Site Setup

TECHNICAL APPROACH

Two Possible Modes of Operation

1. Use only one batch time (worse case time)

2. Measure temperature of each load and remove when 650^{o}F minimum is achieved at multiple measuring points

TECHNICAL APPROACH

- Test Program Divided into 2 Phases
- Phase I select Optimum Basket Design
- Phase II Test Processing Times at Various Densities

TECHNICAL APPROACH

Phase I

- Determine Optimum Tray Design
  - Open enough to have good heat transfer
  - Strong enough to hold up
  - Possibly elevated

TECHNICAL APPROACH

Phase II

- Determine batch times
- Determine if time should be fixed or variable
- Estimate operating costs
- Coupons with explosive contamination to be processed to verify decontamination

TECHNICAL PROGRESS

Phase I Testing Complete

- None of the initial basket designs worked because of high amounts of aluminum in scrap

- New design worked well

TECHNICAL PROGRESS

- Initially, five baskets were fabricated or purchased for testing.

Heavy Duty Baskets

TECHNICAL PROGRESS

Off-the-self / Limited Use Baskets

TECHNICAL PROGRESS

- Examples of the munition types to be processed at Eglin AFB

BLU-97

TECHNICAL PROGRESS

Explosive Coupon Setup

TECHNICAL PROGRESS

TECHNICAL PROGRESS

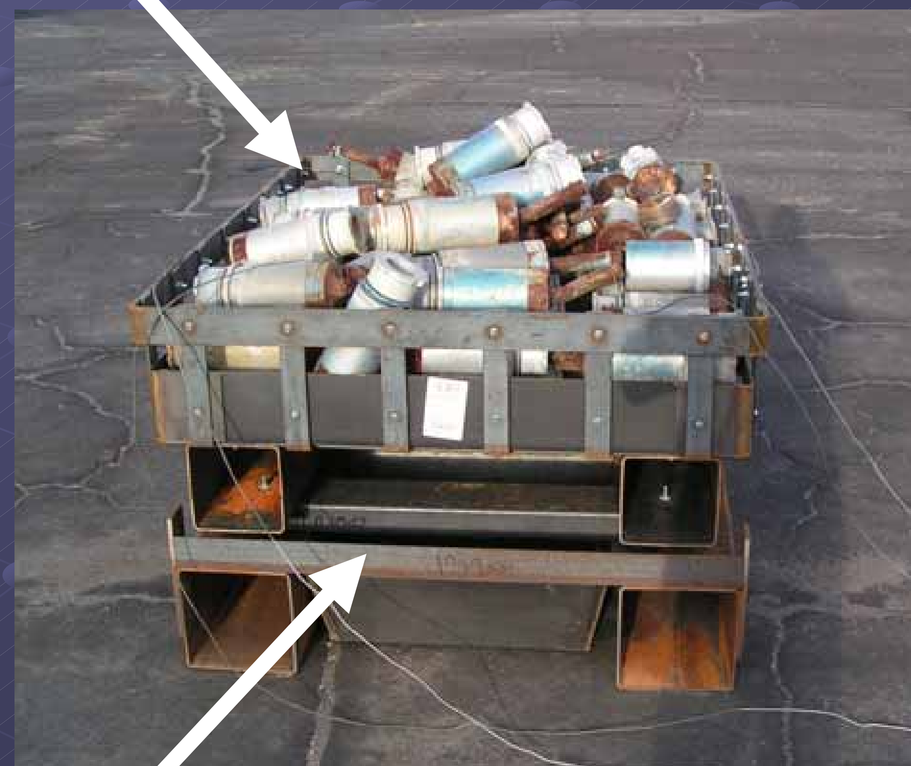
TECHNICAL PROGRESS

Large quantities of Aluminum became a problem

TECHNICAL PROGRESS

- Two more baskets were designed from the lessons learned on the previous five

Munition Baskets



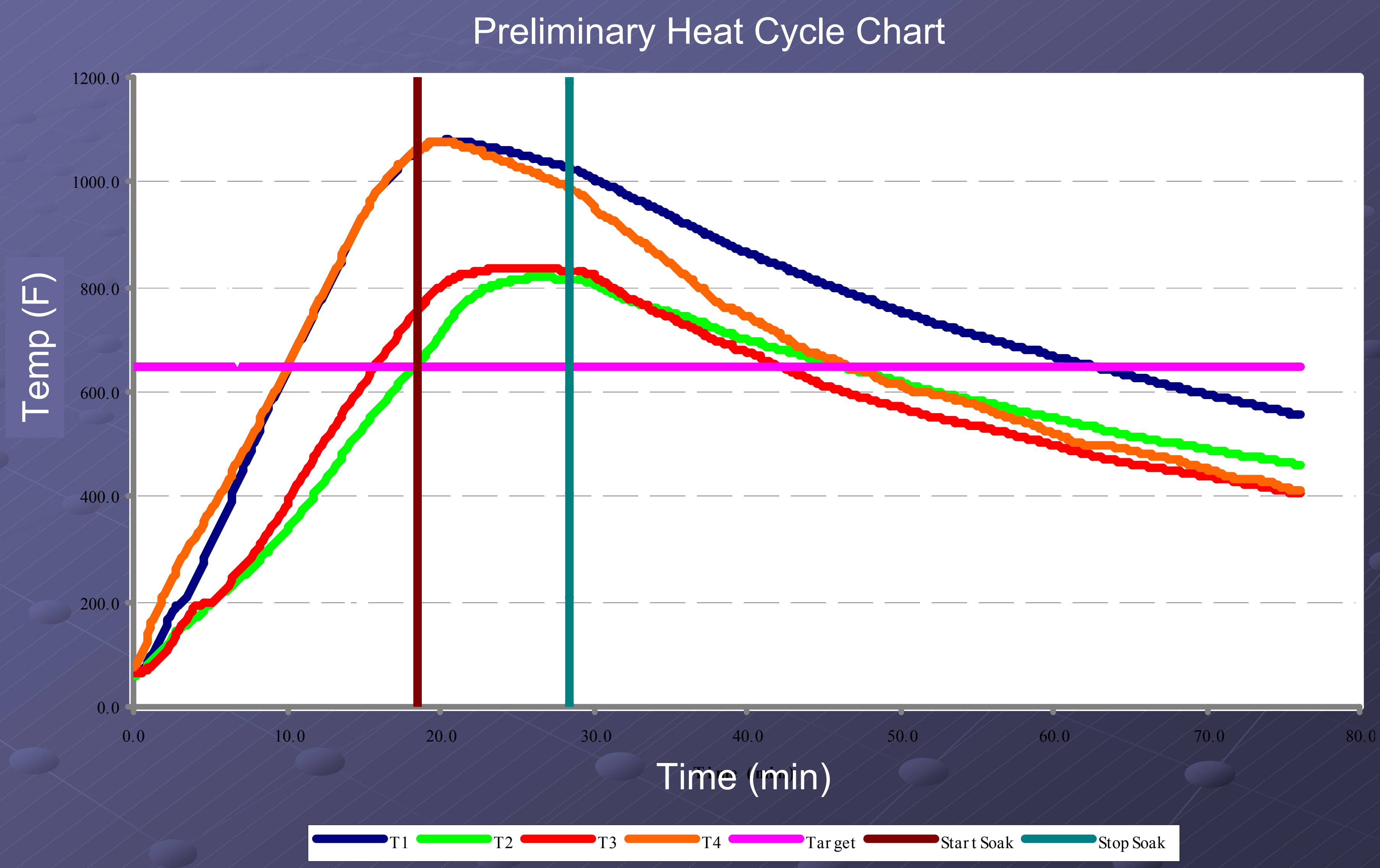
Catch Basins

TECHNICAL PROGRESS

- Final Basket Selection

- Design Benefits
  - Holds up to heat cycle
  - Contains all Aluminum
  - Two pieces for easy loading and unloading

TECHNICAL PROGRESS



TECHNICAL PROGRESS

- Next step
- Conduct Phase 2 Testing
  - Optimization of Operations
    - Each load was instrumented to verify 650°F is reached.
    - Several loads of different density types were processed to determine worst case cycle times.
    - Two explosive test coupons were processed with each load to verify contaminants are eliminated.
    - In addition, two pieces of Target Debris were processed.

RESULTS

- Explosive Coupon Testing
- 650°F all explosives and explosive derivatives were at non-detect levels
- Proved 650°F is the target flashing temperature
- Best to operate in a single batch times

RESULTS

Worst Case Process Times	Minutes
Load / Unload	8
Purge Cycle	2
Heat Time to 650F	40
Heat Soak with Burners Off	10
Cool Down	5
Total Cycle Time	65

TECHNICAL PROGRESS

Target Debris

COSTS

- Operating costs, including fuel & labor, vary between 1.5¢ and 3¢ / lb depending on the aluminum content

OTHER USES

- Demil Scrap Processing
- Process live items with a Strong-Box

OTHER USES

- Smaller version is available

CONCLUSION

- A wide variety of range scrap can be safely processed
- High production rates can be achieved
- Low Costs

Processing Gun Propellants Into Blasting Agents

Hawthorne Army Depot Case Study

Kevin Hansen, TPL, Inc.

Josh Geary, NSWC Crane

Project Overview

Nitrocellulose based propellants are the single largest generator into the demil account each year.

OB/OD are not acceptable options.

Development of blasting agent manufacturing facilities will provide the DoD with the ability to demil large quantities of propellant in an environmentally sound way.

Project Overview

NSWC Crane awarded a contract to TPL, Inc. in September 2002 to develop the capability to produce blasting agents from large grain gun propellants.

TPL developed a blasting agent formulation

TPL BA was tested and accepted by companies within the mining industry in FY04.

Blasting Agent

High propellant content

Maximizes the use of propellant

Accepts multiple propellant types

Competes with and complements, supplements ANFO

Higher detonation velocity – better hard rock breakage

Higher relative bulk strength – expanded patterns possible

Water resistant – no need to pump water

Blasting Agent Facility Overview

Produces BA and BA ingredient from gun propellants

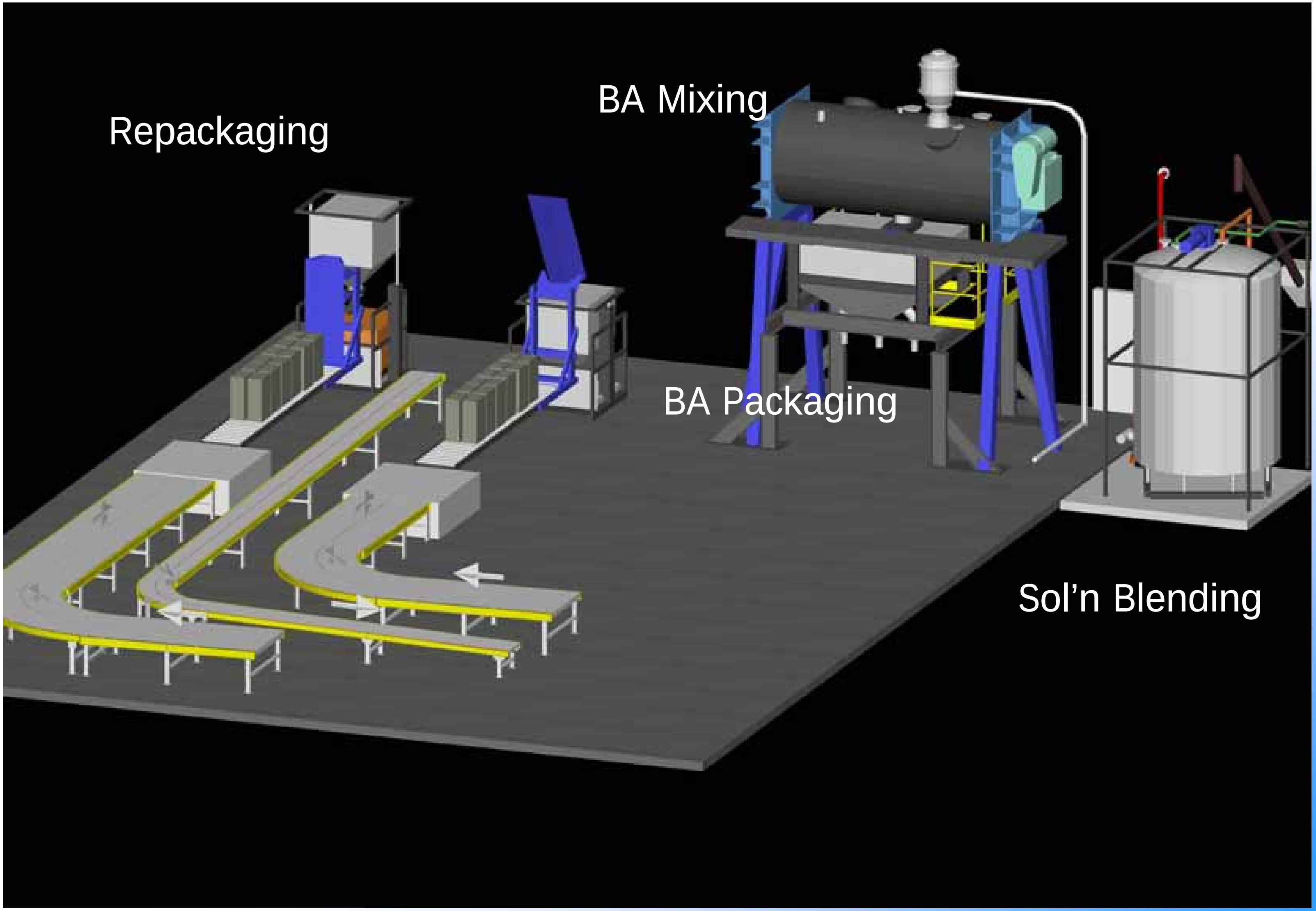
Design production rate of 2000 tons/year

Four Operations

- Repackaging
- Solution/Filler Blending
- Blasting Agent Mixing
- Blasting Agent Packaging

HWAD/D&Z constructing a building to house this system

Blasting Agent Facility Overview



Propellant Repackaging Ops

DoD to DOT Packaging

Input: DoD packaged propellants

Output: DOT packaged propellants

Design Production Rate: 18 tons/shift

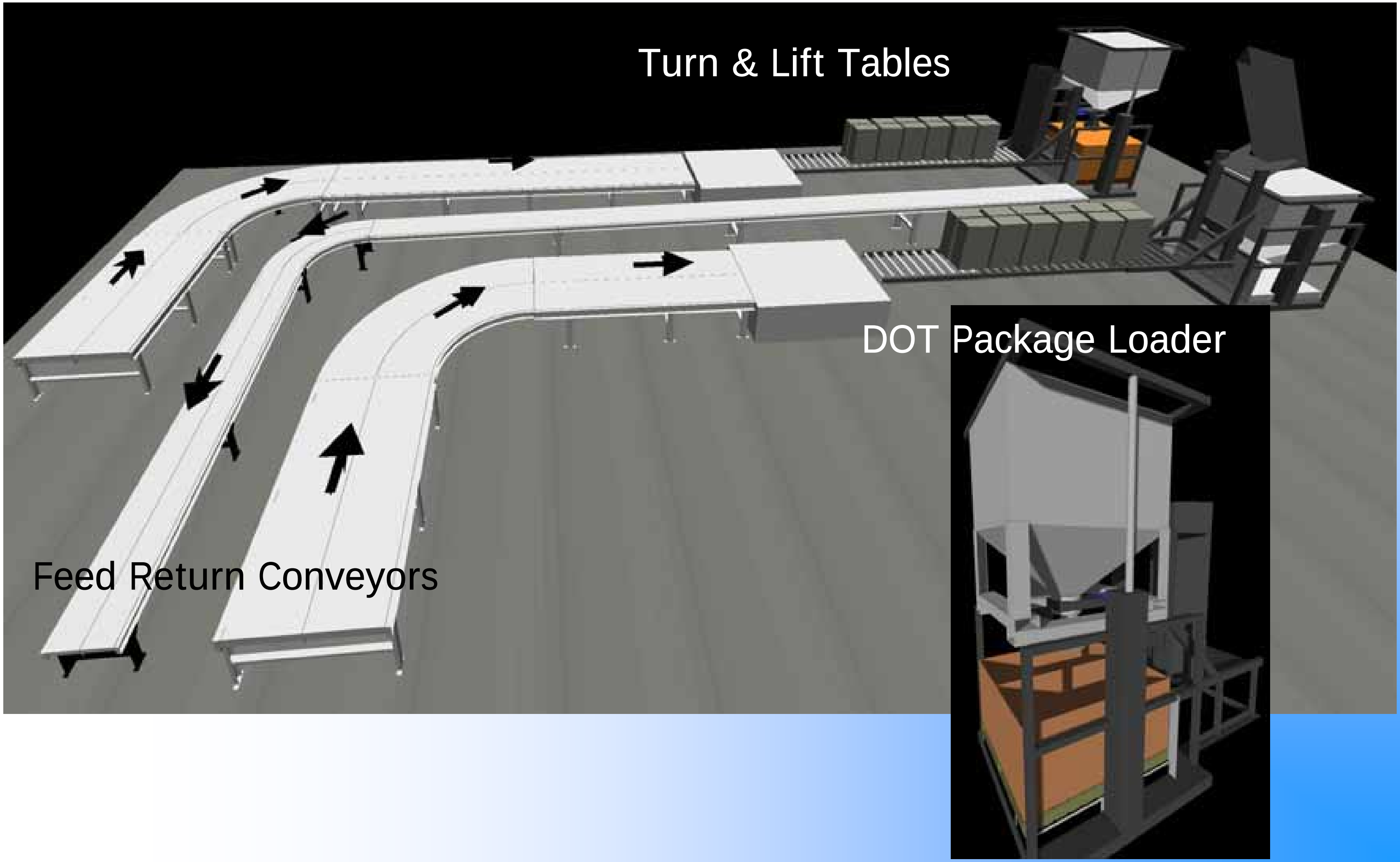
Equipment

- Material handling, Indexing
- Container dumpers
- FIBC loaders

Operation Description

Propellant Repackaging Ops

DoD to DOT Packages



Solution/Filler Blending Ops

Output: viscous oxidizer solution / filler

Inputs: water, nitrates, thickener

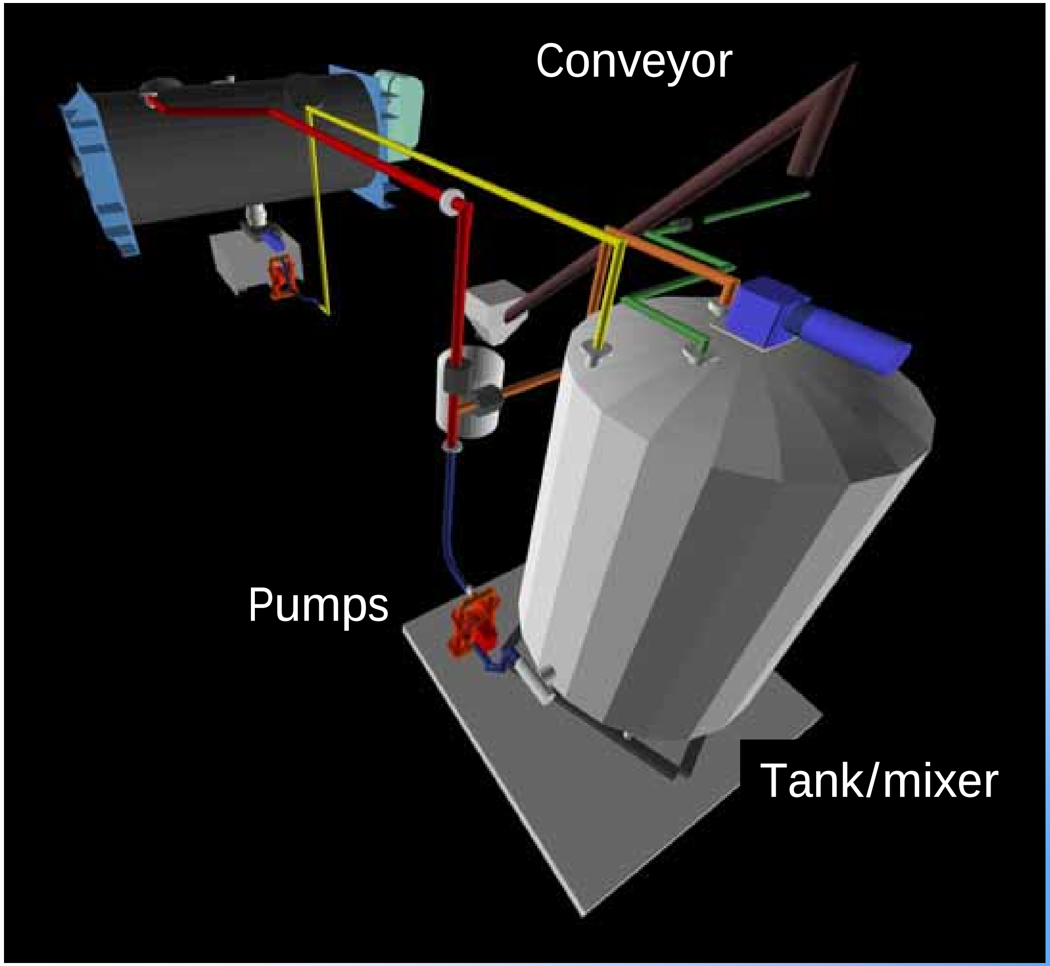
Design production rate: 9 tons / shift

Equipment:

tank, mixer,
pumps,
conveyor,
controls

Operation Description

Solution/Filler Blending Ops



Blasting Agent Mixing Ops

Output: blasting agent 1.5D

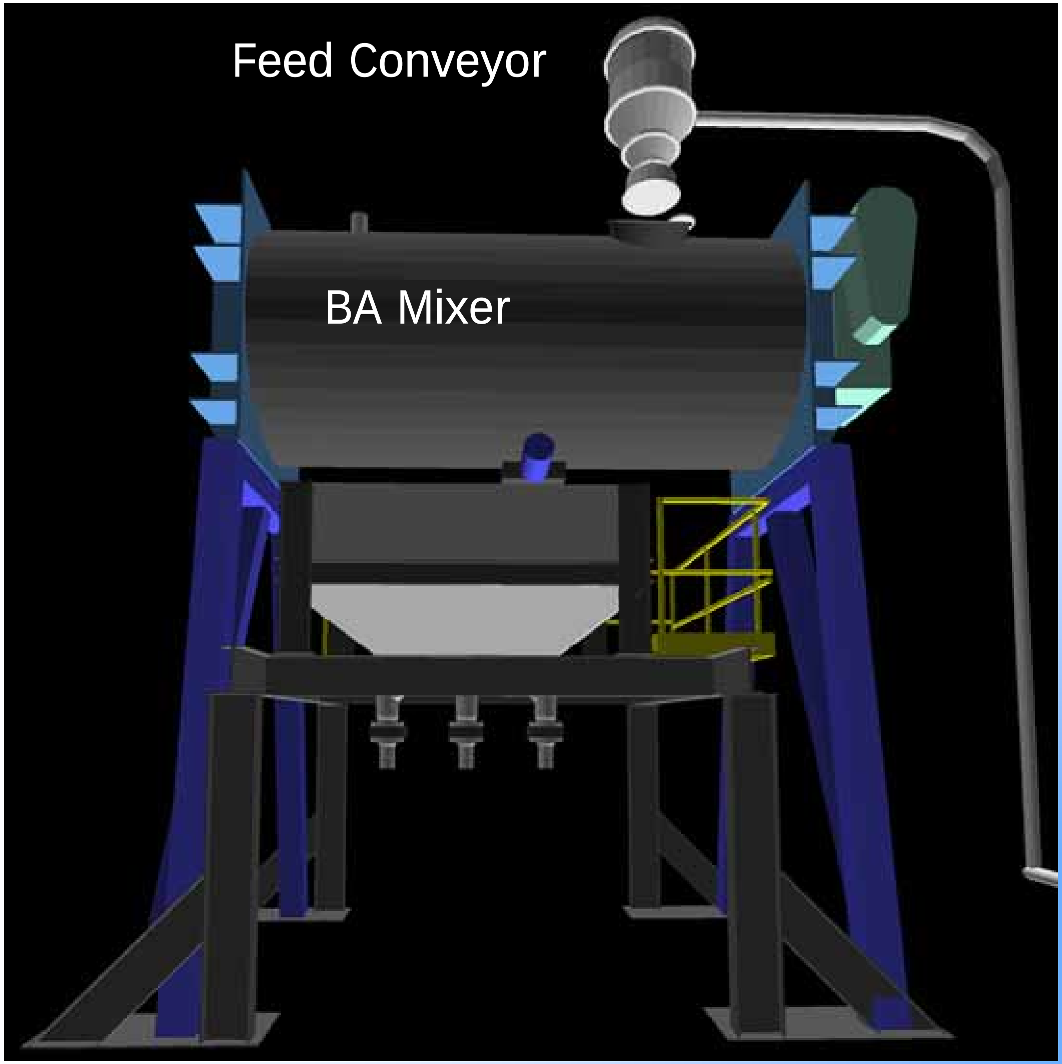
Inputs: solution / filler, propellants

Design production rate: 23 tons / shift

Equipment: ribbon blender, controls, feed conveyor

Operation Description

Blasting Agent Mixing Ops



Blasting Agent Packaging Ops

Output: packaged blasting agent

Inputs: blasting agent, packaging

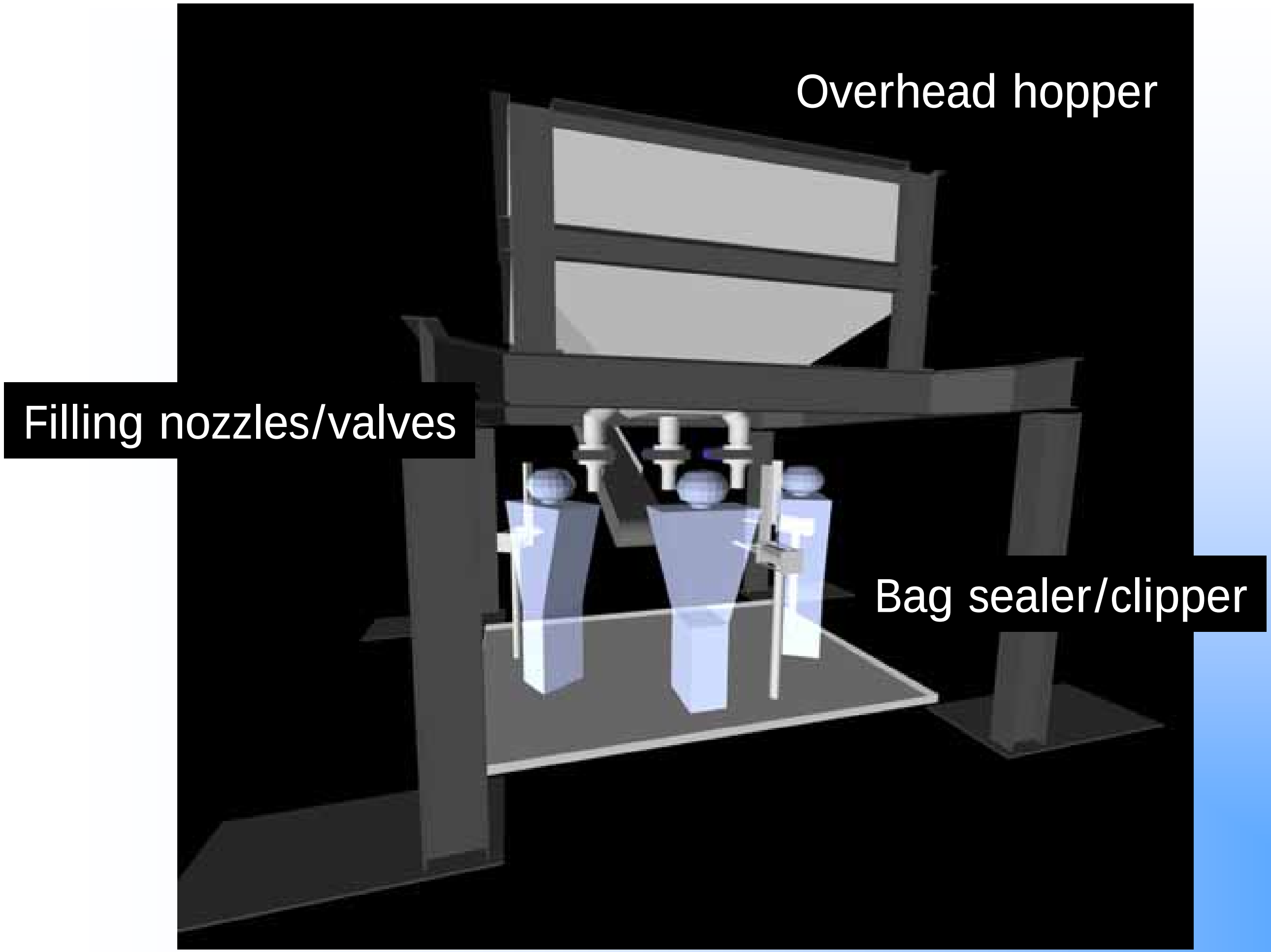
Design production rate, 23 tons/shift

Equipment:

elevated hopper,
filling nozzles/valves,
clippers,
conveyors

Operation Description

Blasting Agent Packaging Ops



Project Summary

As an environmentally friendly alternative to open burning, TPL (with support from HWAD, Day & Zimmermann Hawthorne Corp., NSWC Crane, and DAC) has developed a system to manufacture a high propellant content blasting agent at a rate of about 2000 tons/yr.

That system will begin operations in 4th Qtr 2006.

Acknowledgments

NSWC Crane

Mr. Dan Burch

Hawthorne Army Depot

LTC John Summers

Mr. Florentino Cardenas

Day & Zimmermann Hawthorne Corp.

Mr. Tom Fitzgerald

Defense Ammunition Center

Mr. James Q. Wheeler

PM Demil

LTC Brian Raftery

Overview of the Robotic ADAM Projectile Download Workcell for the Munitions Cryofracture Demilitarization Facility and a Robotic MLRS Warhead Download Workcell

Walter Wapman, Jim Majors, Chuck Yagow,

Terry Barber, J. R. Turner, Gina Talandis

Bob Dedig, and Howard Kimberly

Sandia National Laboratories

and

Greg Olson and Keith Clift

Defense Ammunition Center

and

Larry Gunter, Tony King and John Strange

US Army Aviation and Missile Command

May 3, 2006

Sandia National Laboratories

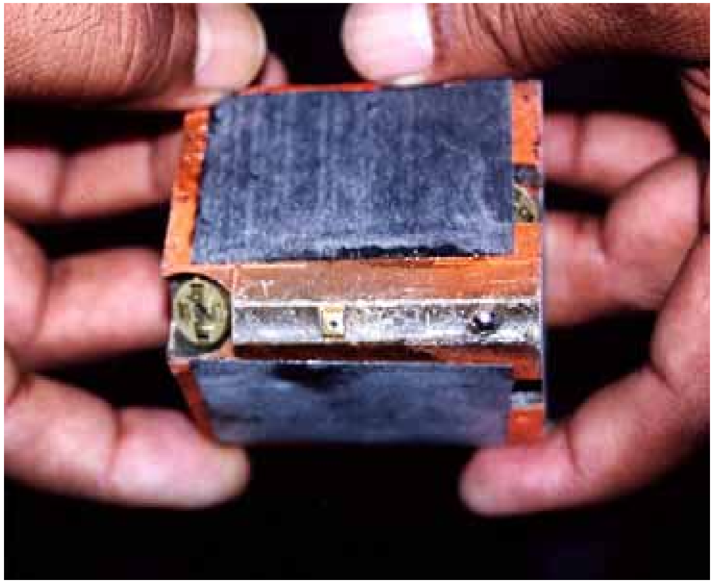
Presentation Outline

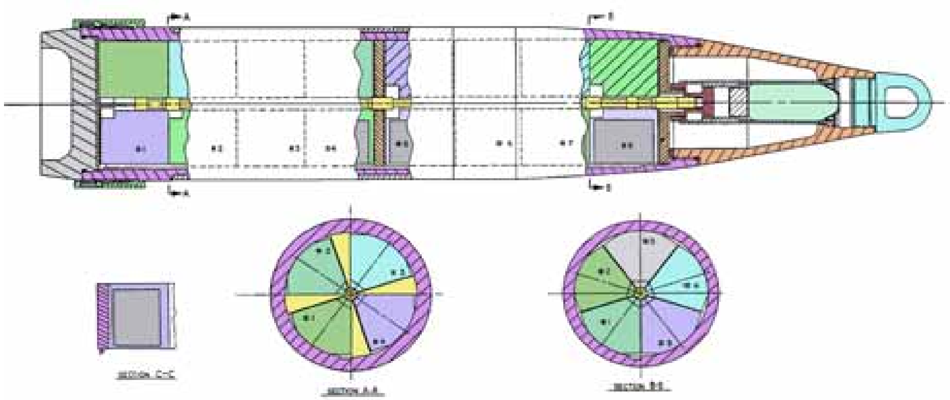
- Adam Mine and ICM Projectile Overview
- Projectile Download Workcell video
- MLRS Download Simulation and videos

Automated ICM Projectile Download Workcell

Sandia National Laboratories

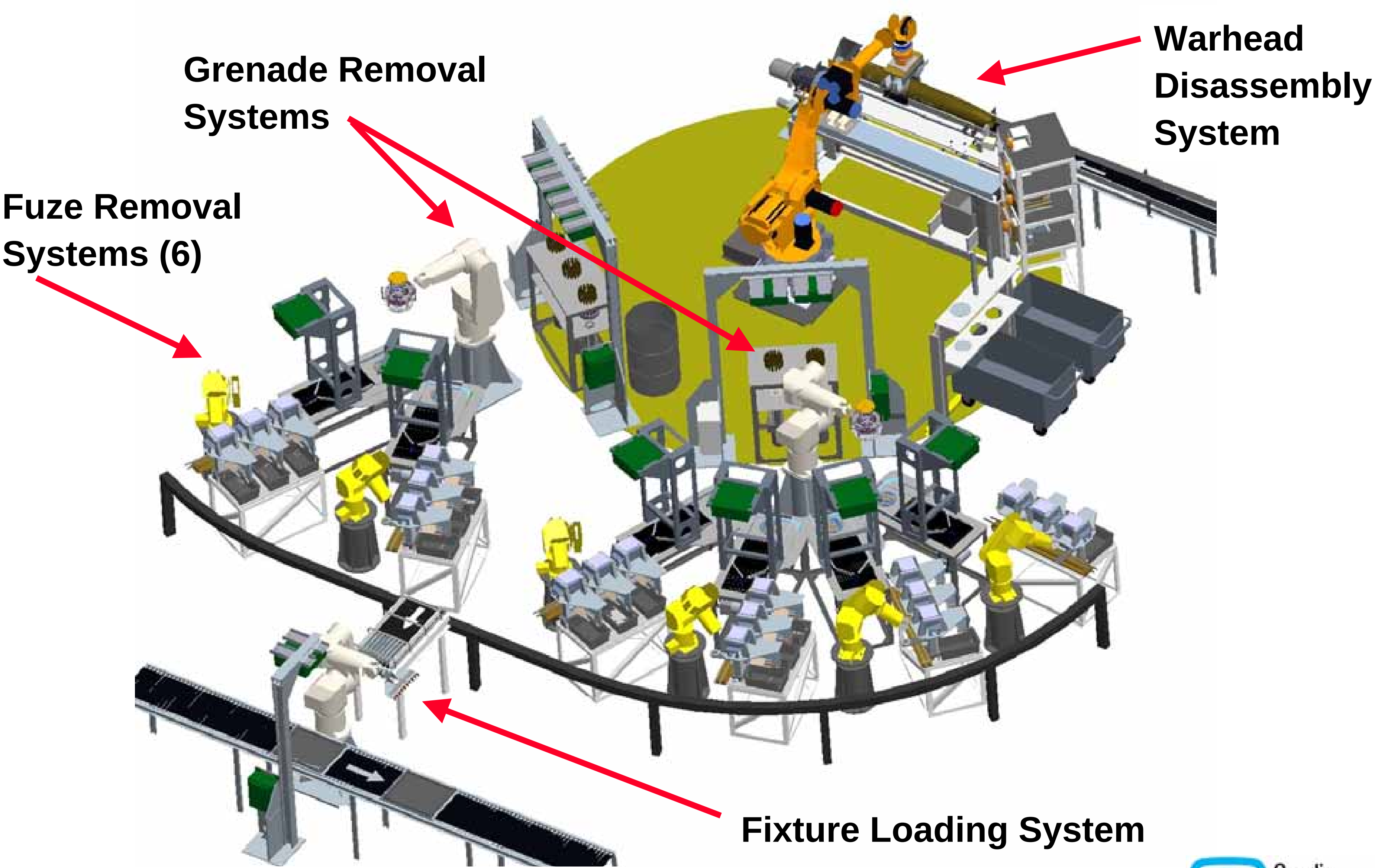
ADAM Mine and ICM Projectile





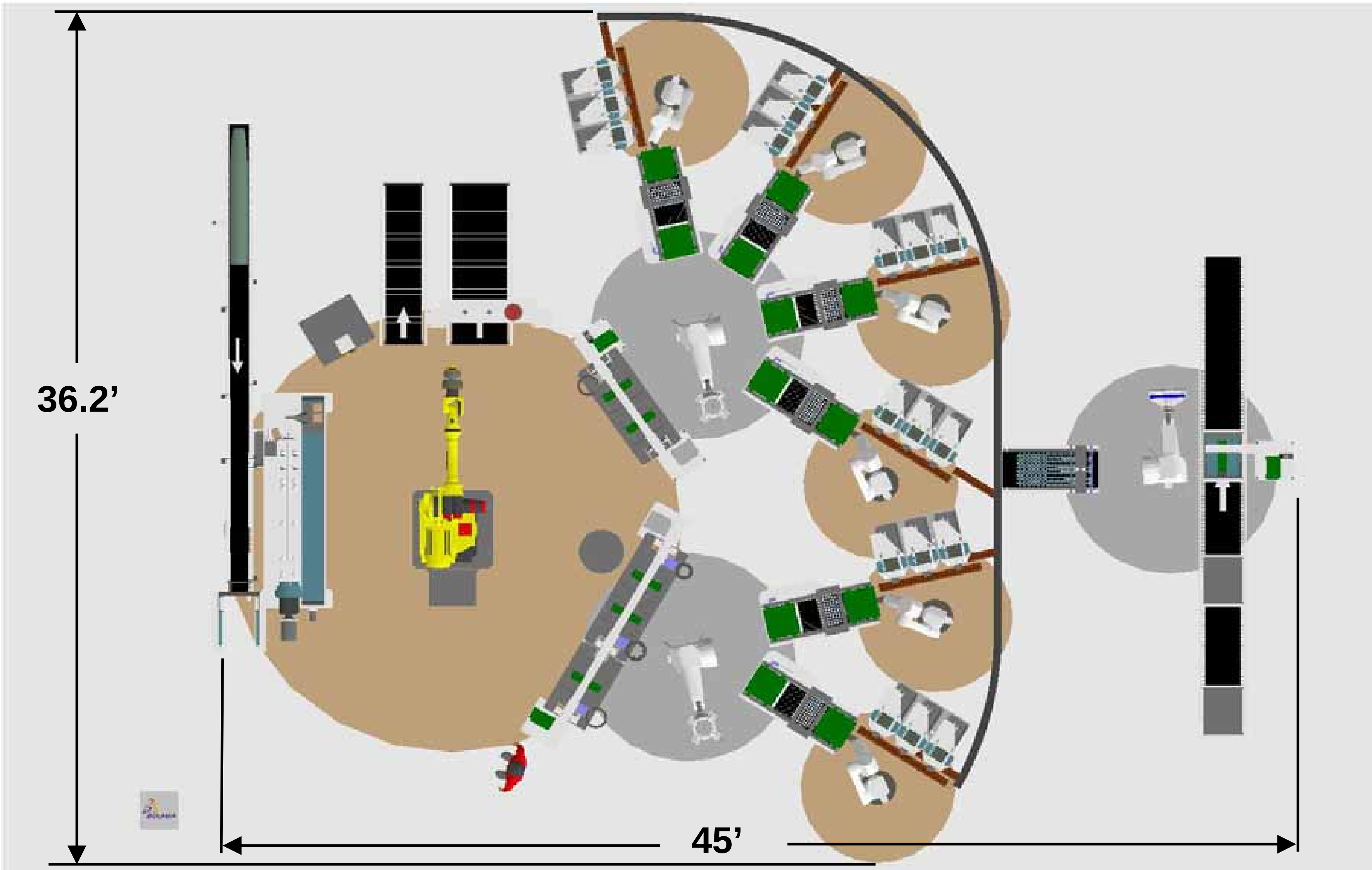
Sandia National Laboratories

Automated MLRS Warhead Download Workcell



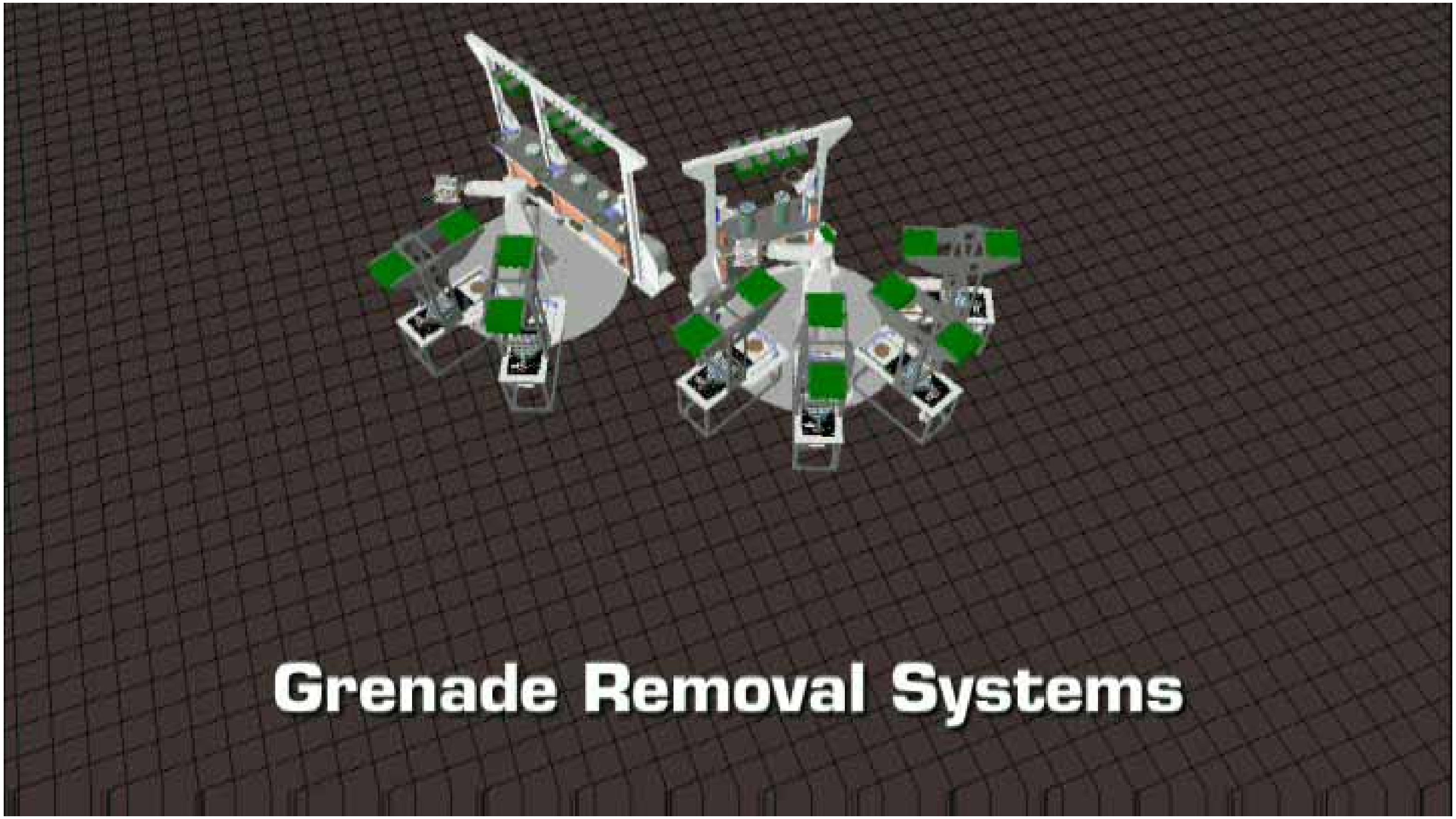
Sandia National Laboratories

Automated MLRS Warhead Download Workcell



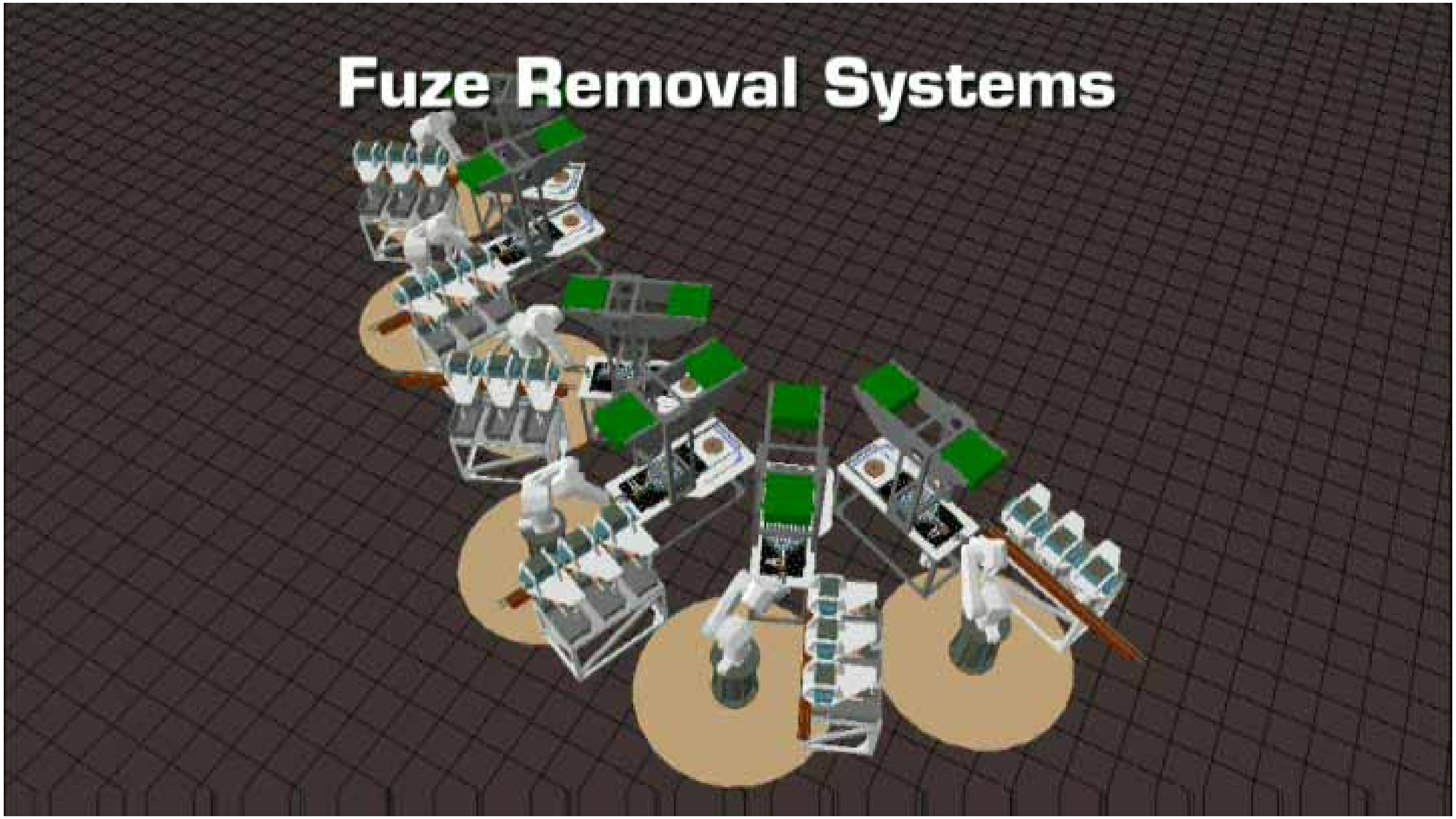
Sandia National Laboratories

Grenade Removal System



Sandia National Laboratories

Fuze Removal System



APE 1995: Propellant Stability Scanner

Global Demilitarization Symposium

Indianapolis, IN • May 2006

Sponsored by: The Defense Ammunition Center and PM-Demil

T. DeAngelis, T. Haskins*,
C. Vincente, L. Kansas
Science Applications International Corporation
D. Herbst
US Army RDECOM-ARDEC

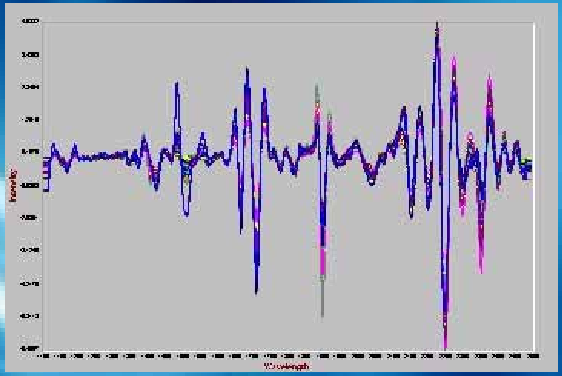
Background

Propellant stability screening in the field

- Real-time, non destructive operation
- Operated by field personnel
- Eleven instruments
- Applicable to eleven propellant types:
  - M1-MP, M1-SP, M6-MP, M6+2, M8-S, M9-F, M10-SP, M14, M38, WC*, SPD*

Deployed in Multiple locations

- McAlester Army Ammunition Plant
- Kuwait
- Tooele Army Depot
- RDECOM-ARDEC



Tooele 20MM Cartridge Program

Demil of 20 mm cartridges

- Contains WC 872 propellant
- Recycled to Blasting slurry
- Requires real time stabilizer analysis to meet state storage regulations
- Requires high accuracy at low stabilizer levels
- OB/OD not possible

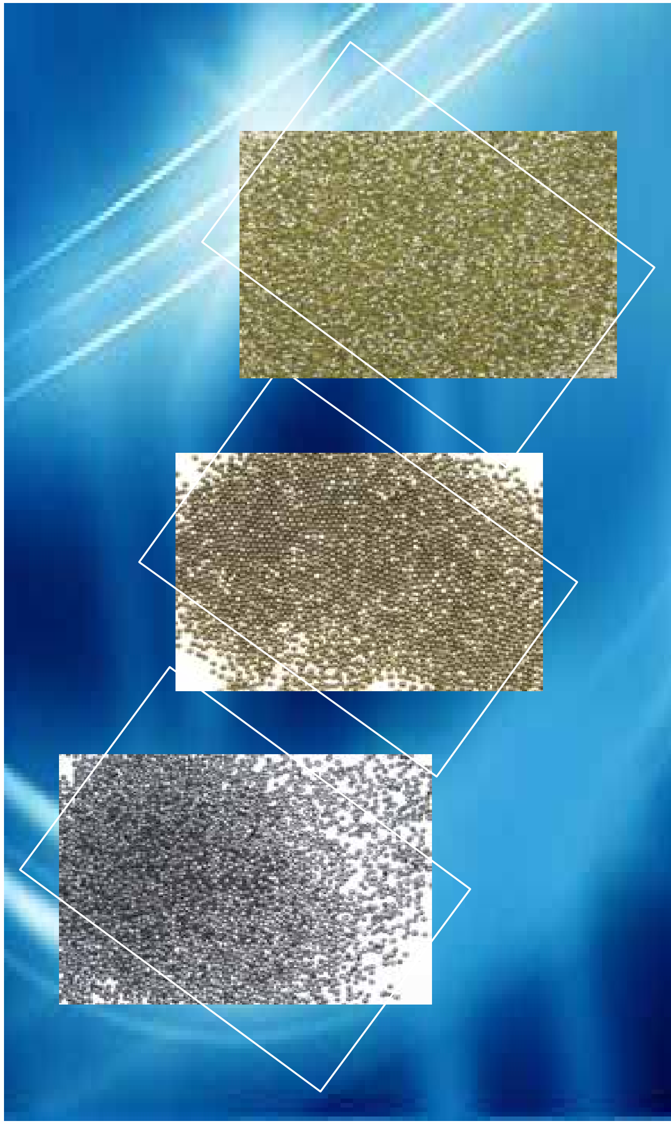
Tooele WC Calibration Curve Development

WC propellant consists of: nitrocellulose, nitroglycerine, diphenylamine, calcium carbonate, sodium sulfate, potassium nitrate, dibutyl pthlalate, and graphite

Propellant types in the WC calibration curve include:
814,818,819,842,844,945,846,870,872,890

Original calibration targeted at 0.45% RES

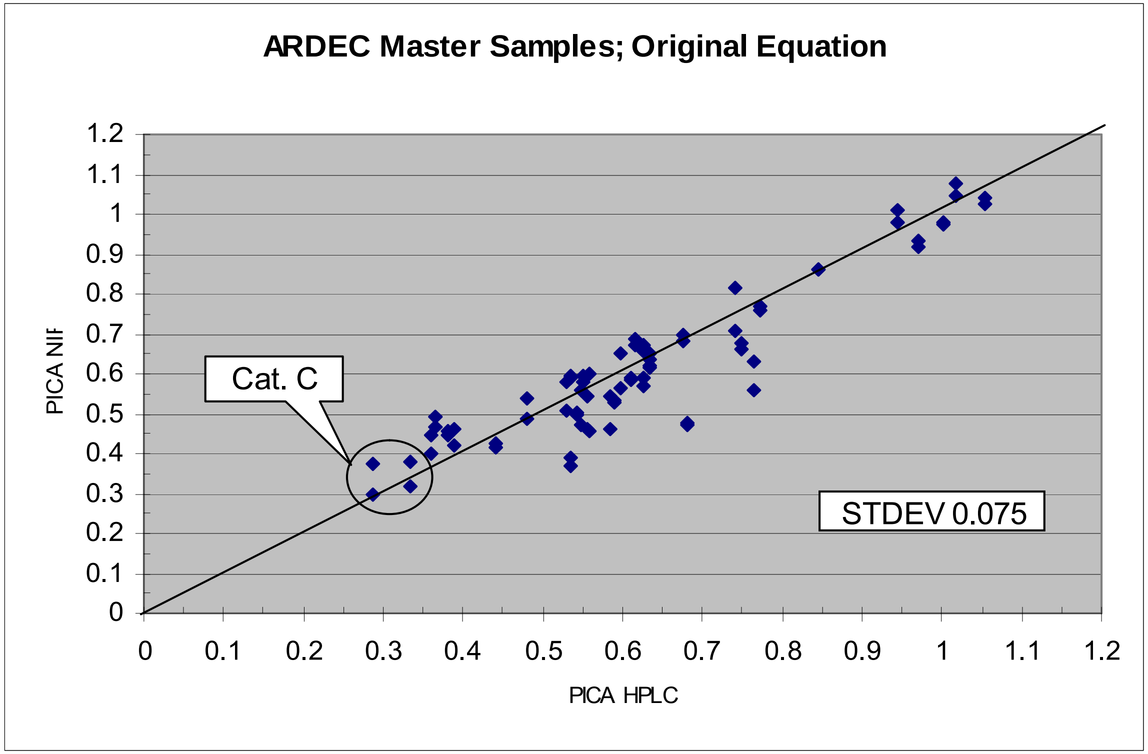
Needed a calibration curve for WC with good accuracy and precision at 0.35% RES



SAIC From Science to Solutions™

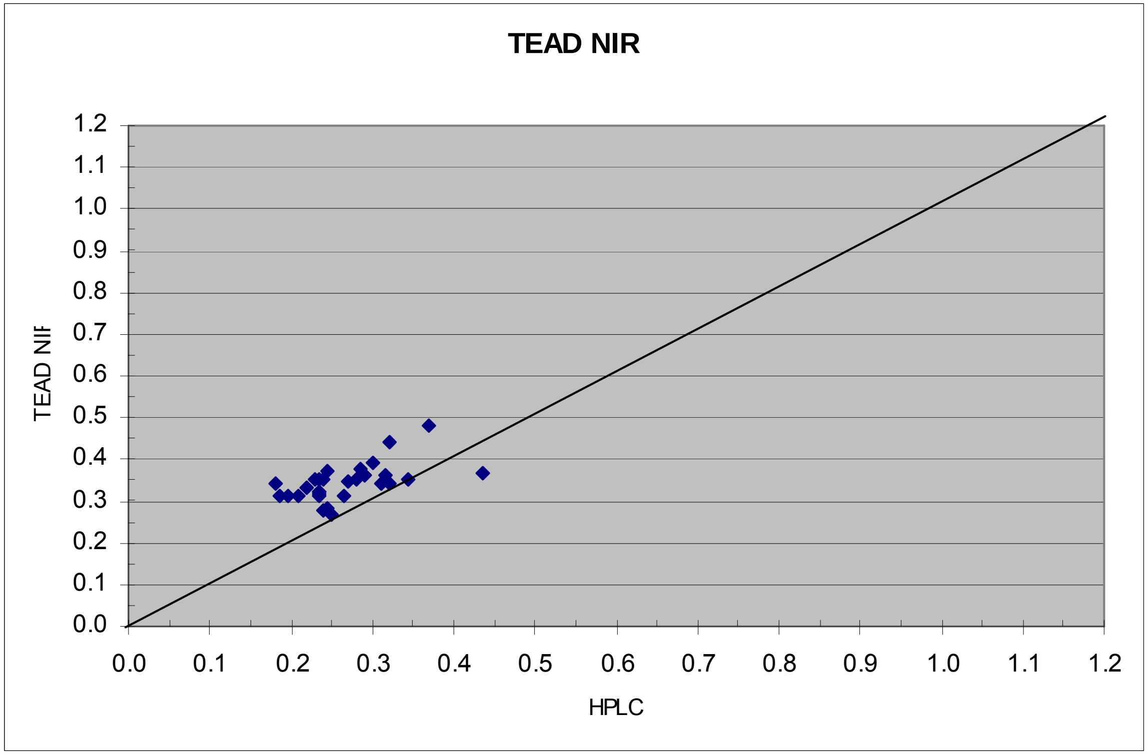
Energetics FROM CRADLE TO GRAVE

Initial WC Calibration Curve



- ARDEC WC Samples
  - From Master lots
  - 0.3 to 1.1 % RES
- Wide sample range
- Statistics
  - 0.45% RES cut-off

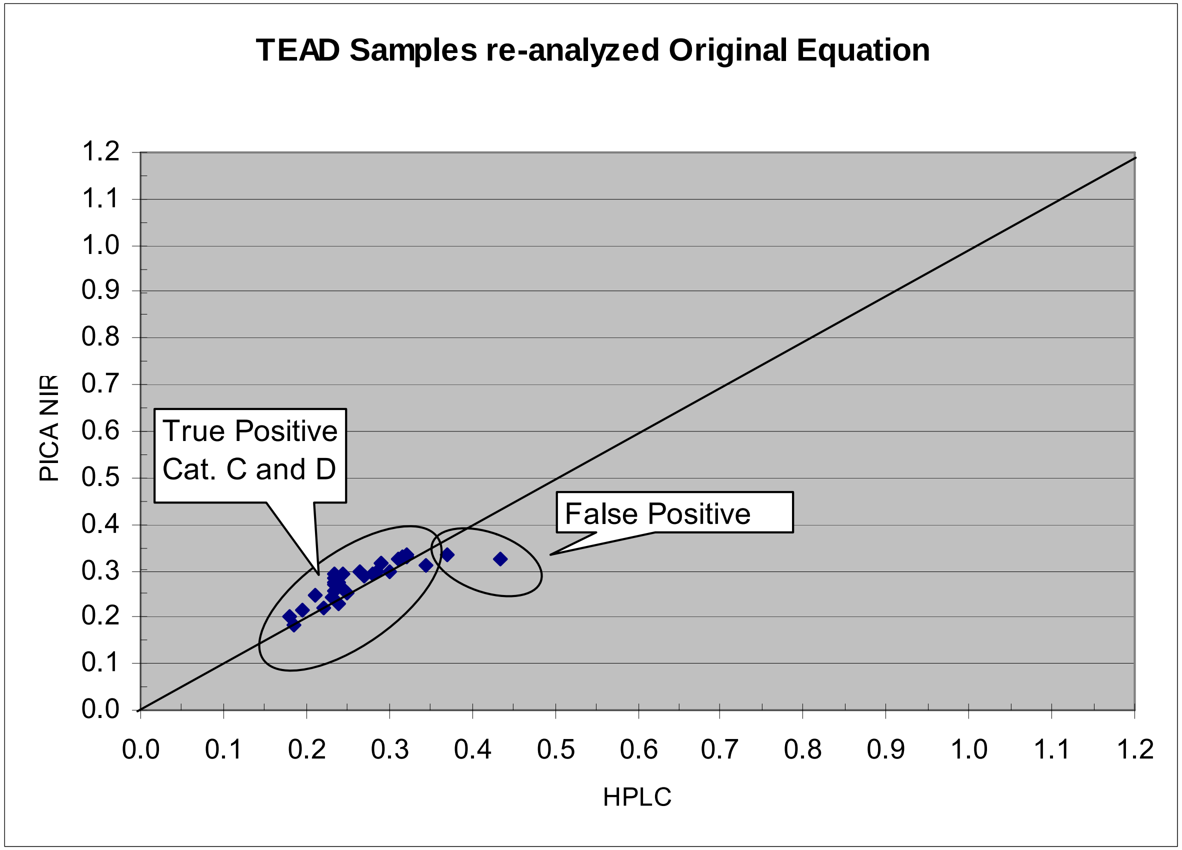
Initial Analysis of Tooele Samples



- **Unacceptable Results**
  - **Fixed offset of TEAD Samples**
  - **Most tested samples outside of the range of the calibration curve**

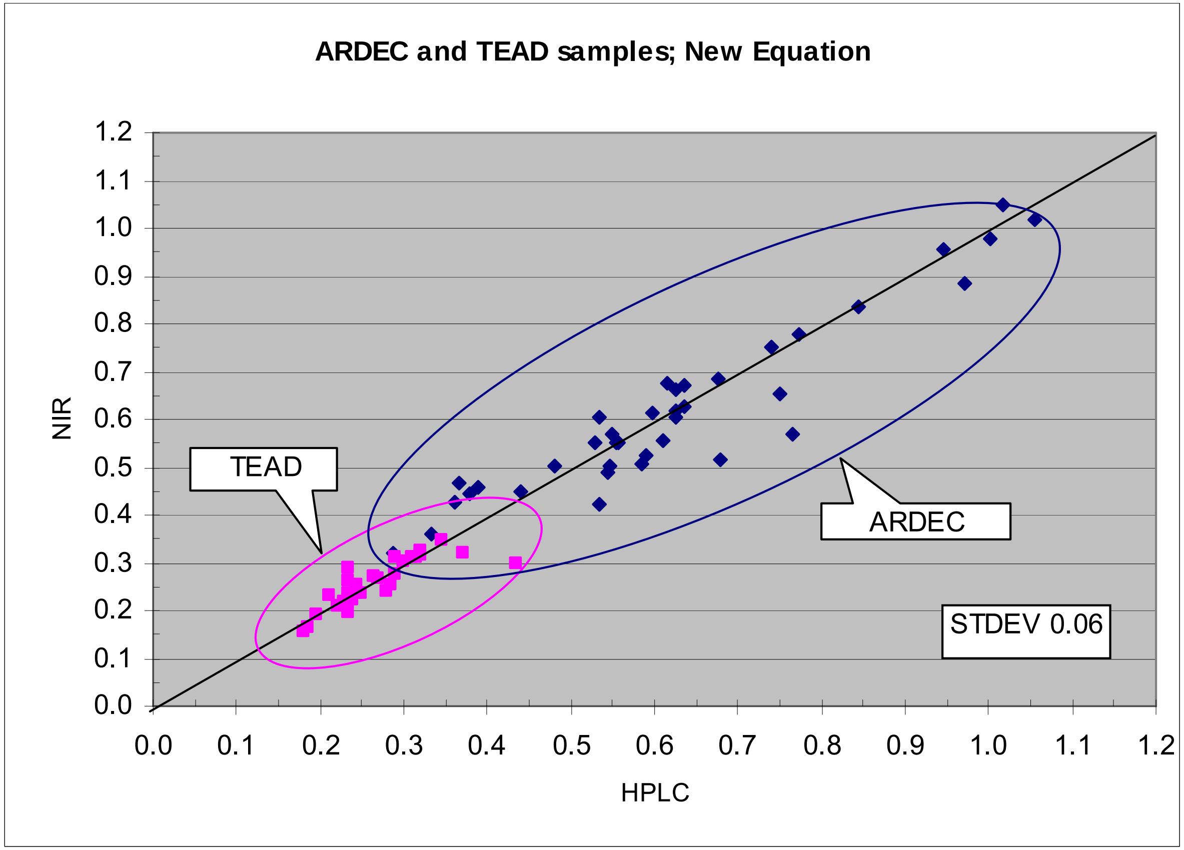
Requires refinement/enhancement of the calibration curve
Insufficient calibration points at low RES levels

Re-analyzed Tooele Samples



- NIR/HPLC correlation significantly improved at the low end of the calibration curve
- Offset eliminated

Improved WC Calibration Curve



Excellent NIR/HPLC correlation through out the range

Real World Analysis Issues

Contaminants in 20 mm WC propellant

- During Demil, fine paint dust and brass shavings are created
- Not observed in laboratory samples
- Studies showed these contaminants did not effect the accuracy of the APE 1995

Tooele APE-1995 Program Status

- Calibration curve completed
- Cut off set at 0.35% RES with SD = 0.06
- Reported to be very user friendly
- No false negatives
- Two instruments in use with good replication between instruments
- In–use, on-line

Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait

Theater operations need real time propellant stability results

To meet this need, theAPE-1995 was deployed to the Third Army/U.S. Army Forces Central Command (ARCENT) /Coalition Forces Land Component Command (CFLCC)

Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait (cont'd)

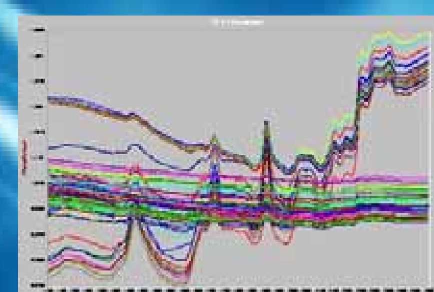
- **Defense Ammunition Center and SAIC personnel:**
  - Demonstrated system operation
  - Trained operators
  - Testing was done entirely by QASAS and military personnel
  - Tested 112 lots of M1and M6
- **Samples shipped to Picatinny for HPLC**
  - Results pending

Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait (cont'd)

- No instrument/analysis issues other than failure of the battery backup due to extreme heat
- Excellent precision (replicate scans) on both instruments
- Good agreement between replicate scans and between results of the two propellant scanners
- Operators trained and equipment in use in an air conditioned workshop
- Will verify results with laboratory HPLC analysis of samples
- Long term effects of dust and sand within the workshop remains to be seen

Future Work – Near-Infrared Propellant Stability Testing

- Develop/enhance calibration curves for other propellant types
- Support TEAD and Kuwait operations
- Update calibration curves on all 11 APE 1995 on rotating schedule
- Evaluate new generation NIR instruments
  - More precise and accurate
  - More rugged
  - Improved software
  - Easier to use



Spectroscopic Detection of Explosives

Global Demilitarization Symposium

Indianapolis, IN • May 2006

T. DeAngelis, K. Shaw*, T. Haskins
C. Vincente, L. Kansas
Science Applications International Corporation
D. Herbst
US Army RDECOM-ARDEC

Introduction

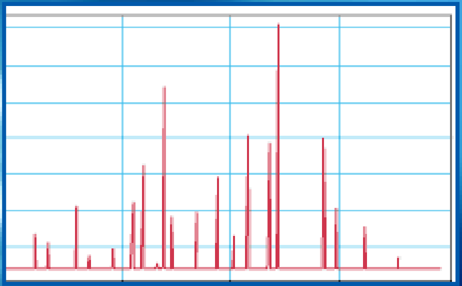
FOUR SPECTROSCOPIES IN SEARCH OF EXPLOSIVES:

Ion Mobility

Raman

Mid Range IR

Near IR



Ion Mobility Spectroscopy

- Sample enters instrument
  - Swipe
  - Vacuum draw
- Highest sensitivity
- Can overload sensor
  - Particularly in contaminated environment or analysis of bulk samples

Swipe sample, place, click, read

EVD 3000

SAIC
From Science to Solutions™

Energetics
FROM CRADLE TO GRAVE

Raman Spectroscopy

- Compact, hand-held package
- Embedded computer
- Penetrates glass, clear plastic
- Applicable to wider sample range than IR

Point, click, read
…*carefully*

Raman Spectroscopy (cont'd)

- Certain energetics, particularly dark samples, absorb laser energy and ignite
- Most energetics won't do this most of the time
- Risk minimized by
  - Using small samples
  - Working behind barrier
  - Avoiding dark samples

Avoid Dark Samples

Mid Range Infrared (MIR) Spectroscopy

- Crystal sample mount
- Internal computer
- Battery-operated
- Explosives reference Library
- Fourier transform (FT)
    - High discrimination
- Attenuated total reflection
    - Compresses sample

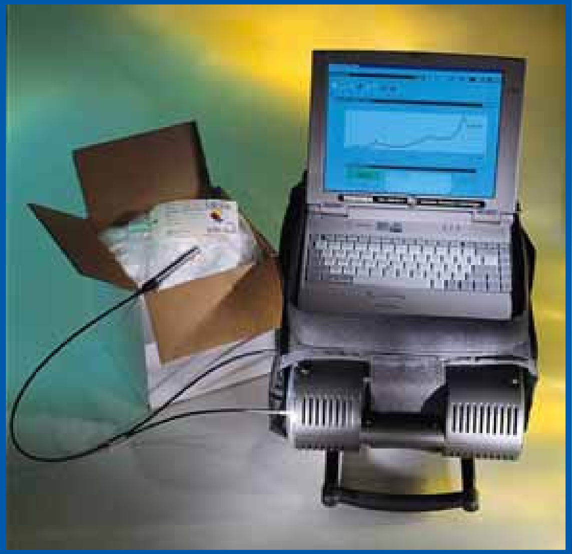
Place, compress, click, read

Smiths Detector

Near Infrared (NIR) Spectroscopy

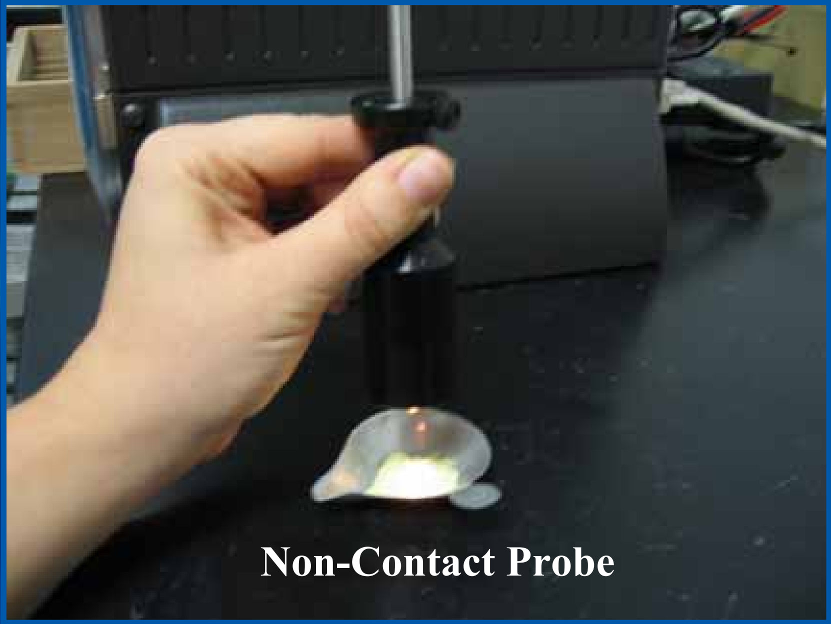
- Identifies bulk explosives
- Fiber optic contact probe, lap top computer, battery operation
- Non-contact probe under evaluation
- One lab unit at RDECOM-ARDEC for quality control, R & D
- Two validated units in the field:
  - ARCENT/CFLCC - Kuwait
  - McAlester AAP

Point, click, read



ASD NIR SPECTROMETER

ASD Probes



- Explosives identified and detection precision and accuracy is nearly identical for both probes
- Development of non-contact probe capability is an important safety feature

ASD Probes (cont'd)

ASD Internal Probe

- Contact library is used
- Probe is smaller and can go where the larger, non-contact probe cannot

Comparative Features: Near-IR, Raman, Mid-IR, Ion Mobility

Feature	Technology			
	IM	Raman	MIR	NIR
Automatic ID display	X	X	X	X
Battery operation	X	X	X	X
Low ignition risk	X			X
Low level detection		X	X	
Trace detection	X			
Comprehensive explosives library			X	X
Fiber optic probe		X		X
“Sees” thru glass, plastic, etc.		X		X

Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait

- **Provide Unique Tools for Warfighter Support**
- **Conduct on-site training for local QASAS**
- **Evaluate performance under SWA conditions**
- **Elicit user feedback**
- **Incorporate new scans and data into existing calibration models**
    - **Expand library to extend sample range**
    - **Improve accuracy, reliability**

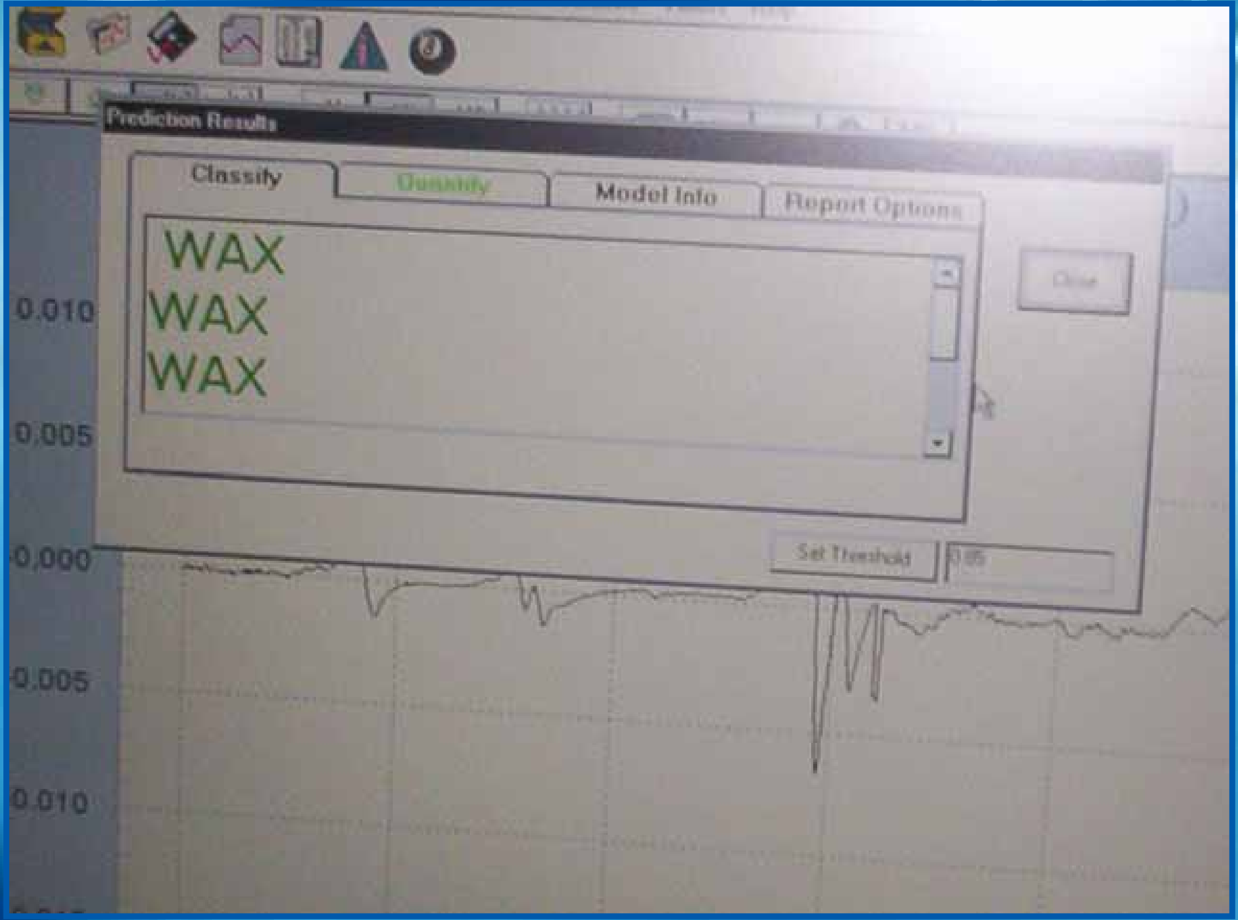
Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait

Unknown Fill: 60mm Mortar Round

Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait

Analyzing Mortar Rounds

Results:


Prediction Results
Classify
Model Info
Report Options
WAX
WAX
WAX
0.010
0.005
0.000
0.005
0.010

Deployment to ARCENT/CFLCC, Camp Arifijan, Kuwait

Edward Prad Outdoors w/ Explosives Scanner

Future Plans

- Demonstrate detection capabilities at additional sites
- Support field operations
- Expand explosives libraries
- Evaluate new technologies

Demilitarization of Munitions Recovered From Burial Sites Using High Production Rate Confined Detonation Chambers

Global Demil Symposium

Indiana Convention Center

Indianapolis

May 1-4 2006

UXB International

1715 Pratt Dr

Blacksburg, VA 24060

Phone: (540) 443-3746

Presentation Overview

I. Introduction

II. Project description

III. Removal of materials from tunnels

IV. Demil plant description

V. Demil experience

VI. Conclusion

Introduction

- 40 year old munitions buried in tunnels required removal and destruction
  - *All types of munitions*

- *Projectiles*
  - *HE*
  - *Smoke*
  - *Illumination*
- *Mines*
  - *AP*
  - *AT*
- *Rockets*
- *Grenades*
- *Fuzes*
- *Detonators*
- *Boosters*

Project Description

- Munitions were buried in concrete in tunnels
  - Required careful removal from concrete prior to demil
  - Increased scrap load requiring disposal
- Existing Infrastructure minimal
  - Generator required, plant was built from scratch and was completely removed after project completion

Munitions in Tunnels

- Poor to very poor condition
  - Rusted
  - Corroded fuzes
  - Unstable propellant
  - Identification difficult
  - Mixed munitions

Munitions in tunnels

Munitions were in very poor condition

Unstable Propellant

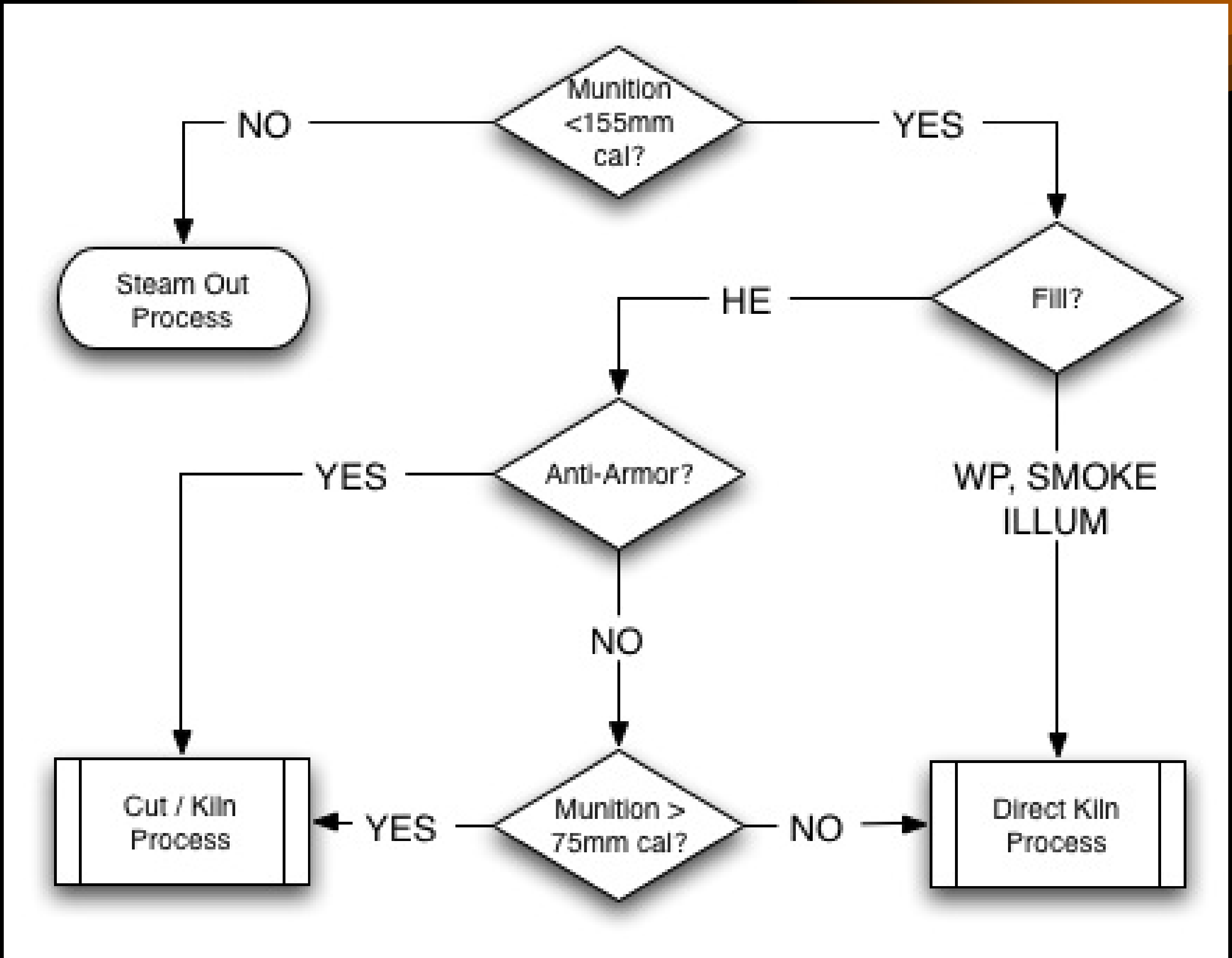
Removal action

- Removal was done slowly and carefully
  - Manual operation
  - EOD techs used exclusively
  - Procedures developed
  - NO accidents, injuries

Demil Plant description

- Plant was built from scratch
- Equipment included
  - Robotic water jet cutting
  - Remote water cooled saws
  - Base hydrolysis
  - Steamout/ Meltout
  - Heated Detonation Chambers (2)
    - SDC 1200
    - SDC 2000

Demil Flow


Munition <155mm cal?
NO
YES
Steam Out Process
Fill?
HE
Anti-Armor?
WP, SMOKE ILLUM
YES
NO
Cut / Kiln Process
YES
Munition > 75mm cal?
NO
Direct Kiln Process

Steamout/ Meltout

Munitions for steamout

- TNT Filled
  - 240mm
  - 8 inch
  - 155mm

Steamout Results

- **45 tons TNT recycled**
- **Shells flashed, demilled, steel returned to client**

Robotic Water Jet Cutting

UXB Multi-Axis Programmable Ammunition Cutter (MAPAC)

- Completely automated unmanned operation
  - Robot removed munition from rack
  - Brought munition to cutting head
  - Munition cut with abrasive water jet
  - Robot took cut munition to inspection station
    - Robotic vision system verified cut munition
  - Cut munition placed on belt for delivery to hot detonation chamber

MAPAC

Unit shown cutting a 75mm projectile

Dynasafe Static Detonation Chambers

- 2 units used
  - SDC 1200
  - SDC 2000
- Heated confined detonation chambers
  - High production process equipment
  - Minimal to no feed preparation required

SDC 1200 Description

All fragments, noise contained

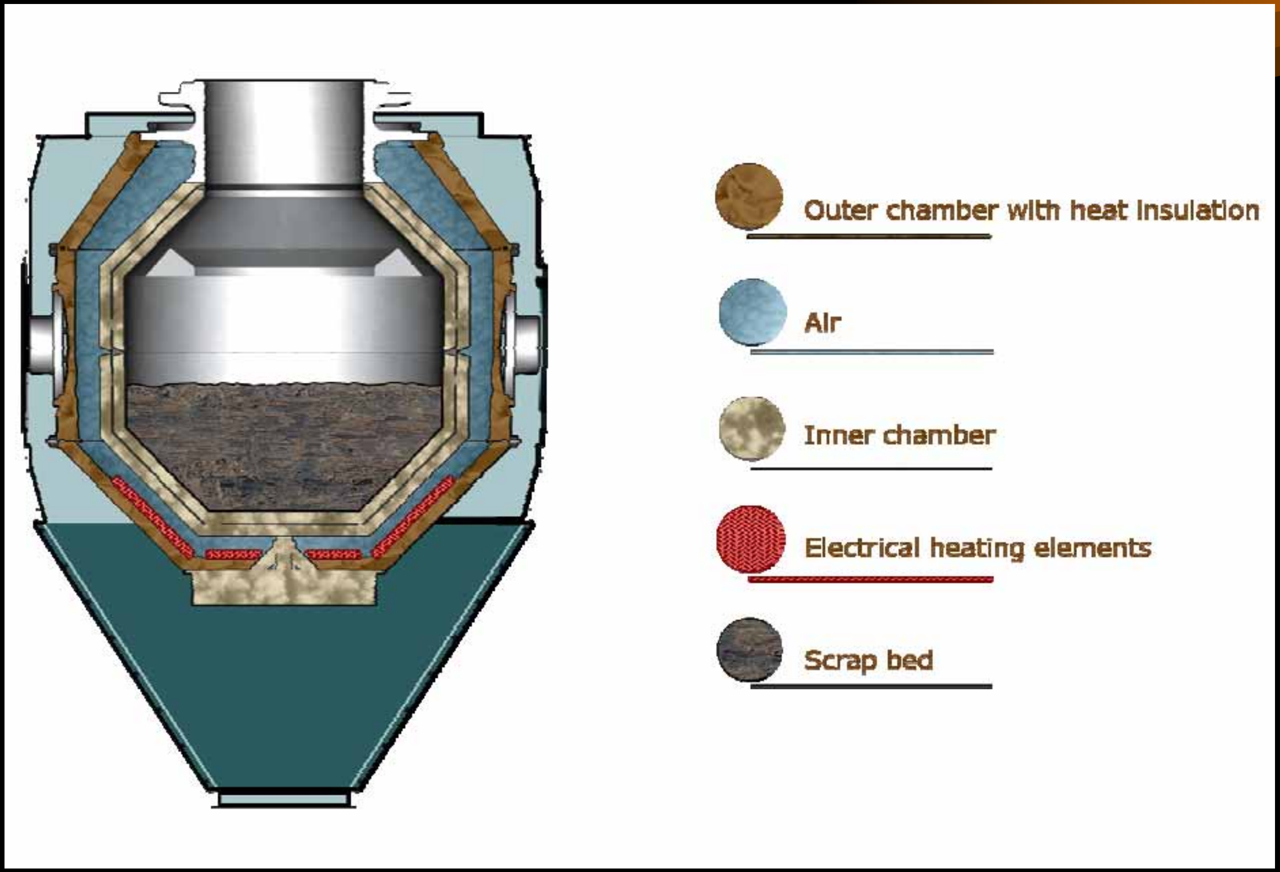
- Detonation gasses treated before release
  - Met all host country emissions requirements
- Scrap treated to 5X conditions (550C/1022F for 15 minutes)

SDC 1200 Installation

SDC 2000 Description

- Dual walled chamber design
- Indirect heating
- High temperature Stainless Steel construction
- Automatic feed
- Operating temperature 550 C

Cutaway view of Destruction Chamber (SDC 2000)



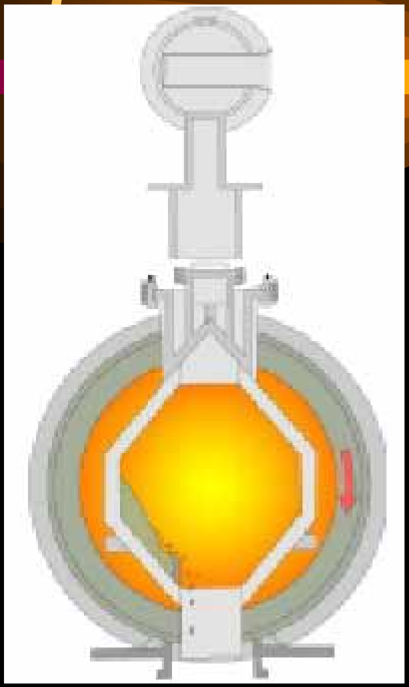
SDC 2000 - Advantages

- No preparation of feed munitions needed in most cases
- No donor explosives required for
  - Explosively configured rounds or
  - Non-explosively configured rounds
- Scrap metal 5X (1000°F, 15 min)
- SDC is a Production oriented piece of process equipment, built to minimize risk, handling of munitions

SDC2000 Installation

SD Operation

180^{o} Rotation



During Operation:

Munitions fed into
top of inner chamber for
thermal pyrolysis destruction

After Operation:

Vessel rotated to
discharge scrap
materials

Destruction Chamber SDC 2000

- Made of high temperature stainless steel
- Double walls for safety (each wall capable of containing all shock, fragments, gasses)
- Electrically heated, reduces gas treatment requirements

Munitions Feed System

- Automatic (unattended)
- Munitions passed through 2 airlocks before entering chamber

Off-gas Treatment

- Fully compliant with EU Regulation 2000/76/EC.
- Can process conventional munitions, WP, smokes, bulk explosives

Main Components:

- cyclone
- Oxidizer
- quench
- scrubber
- stack

Scrap was at a 5X condition

Actual Production rate experience

Sl. No.	DESCRIPTION OF REJECTED AMMUNITION/ EXPLOSIVE	ACTUAL QUANTITY DESTROYED	DEMIL PROCESS	ACTUAL SHIFTS REQUIRED	CALCULATED PLANT CAPACITY UNITS /SHIFT (10-HOUR SHIFT)
1	Cap Precussion	74,175	DIRECT FEED	0.1	741750
2	Booster Cup	26,900	DIRECT FEED	2.7	9963
3	Detonator	16,415	DIRECT FEED	2.1	7817
4	Cartg. 20mm HE	54,496	DIRECT FEED	7	7785
5	Cartg. 30mm HE	30,005	DIRECT FEED	5.5	5455
6	30mm HE	7,154	DIRECT FEED	1.8	3974
7	Cord Detonating, Meters	200	DIRECT FEED	0.1	2000
8	Cartg. 40mm	19,809	DIRECT FEED	10	1981
9	Electric Fuze	180	DIRECT FEED	0.1	1800
10	Mine M-3 (A/P)	2,316	DIRECT FEED	1.5	1544
11	Hand Grenade MK-2	3,952	DIRECT FEED	3	1317
12	Mine M-14	2,731	DIRECT FEED	3.5	780
13	Flare Trip Wire	1,200	DIRECT FEED	2.5	480
14	Mortar, 60 HE	1,995	DIRECT FEED	4.5	443
15	Cartg. 57mm Recoilless	4,795	DIRECT FEED	11.8	406
16	Cartg. 75mm Recoilless	32,149	DIRECT FEED	95	338
17	Cartg. 105mm HE	5,647	CUT / FEED	18.5	305
18	Mortar, 81 HE	293	DIRECT FEED	1	293
19	Cartg. 106mm Recoilless HEAT	18,948	CUT / FEED	65	292
20	FUZED MINE AT 1B ND	14,106	CUT / FEED	50	282
21	Mine M-2 (A/T)	924	DIRECT FEED	3.5	264
22	Rifle Grenade 73 mm HEAT	9,147	CUT / FEED	35	261
23	68mm Rocket Warhead	741	DIRECT FEED	2.9	256
24	Mortar, 4.2" HE	1,654	CUT / FEED	7.5	221
25	Cartg. 100mm HE	871	CUT / FEED	4	218
26	Cartg. 76mm HE	90	CUT / FEED	0.5	180
27	Proj. 75mm WP	5,145	DIRECT FEED	35	147
28	Mortar 60 WP	825	DIRECT FEED	7	118
29	Proj. 155 HE	874	CUT / FEED	9.2	95
30	Mortar 81 WP	276	DIRECT FEED	4	69
31	Mortar 81 Illum.	475	DIRECT FEED	7	68
32	Proj. 105 WP	1,291	DIRECT FEED	22	59
33	Proj. 155 Illum.	1,305	DIRECT FEED	26	50
34	Mortar 4.2" WP	841	DIRECT FEED	19	44
35	Proj. 155 WP	990	DIRECT FEED	65	15

Conclusions

- Project was completed on time, on budget
- No one injured
- Plant was demobilized at conclusion
- Lower life cycle costs
- High safety

Demilitarization/Disposal Challenges

Demilitarization of Training Munitions & Range Residue

2006 Global Demilitarization Symposium & Exhibition
May 1-5, 2006

Presented By: UXB International, Inc.

Range Residue - Some Issues

- ✓ Closed Loop System – Chain of Custody
- ✓ Cost Benefit Analysis for “Fine” processing of residue
- ✓ Value of recovered residue (Scrap Metal)
- ✓ Transportation to Fixed Processing Site and/or Insitu Processing
- ✓ Risk... when does it cease to be range residue or Material Potentially Presenting an Explosive Hazard (MPPEH)?
- ✓ What can “we” afford?

The Problem at a Glance

The Problem at a Glance

The Problem at a Glance

Range-Related Debris and Target Material

The Problem at a Glance

Typical Unserviceable Target / Range-Related Debris

The Problem at a Glance

Range-Related Debris and Target Material

The Problem at a Glance

Range-Related Debris and Target Material

The Problem at a Glance

The Problem at a Glance

Targets are also MPPEH -- removal, processing, disposal

UXO Lodged in Target / Range-Related Debris

The Problem at a Glance

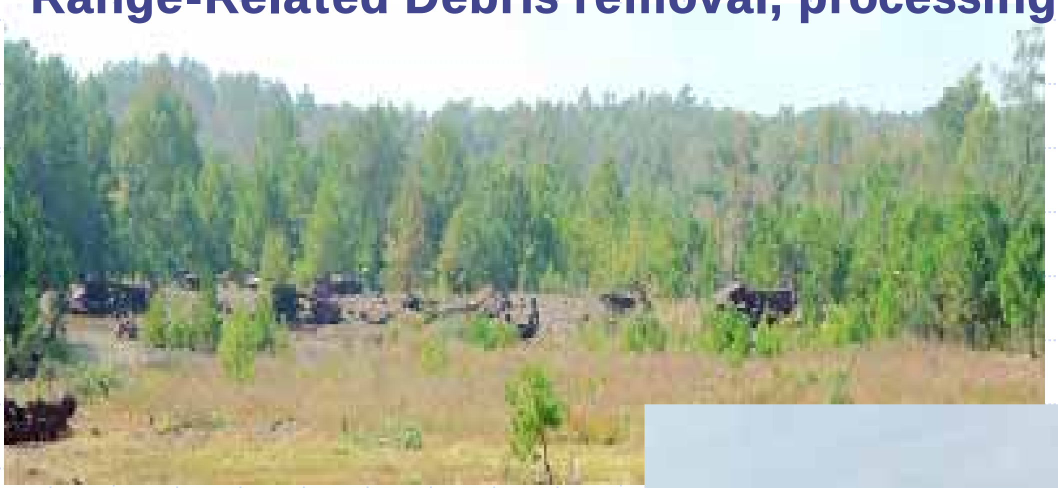
Range-Related Debris Removal

Range-Related Debris and ordnance removal, processing, disposal

Range-Related Debris and Ordnance removal

Range-Related Debris Removal

Range-Related Debris removal, processing, disposal



Range Cleanup Before and After

Range-Related Debris Removal

Range-Related Debris removal, processing, disposal

Range-Related Debris Removal

The Desired Result

Range-Related Debris Processing

Old target and Range-Related Debris recycling

Range-Related Debris and Target Material

Range-Related Debris Processing

Old target and range residue recycling

Range-Related Debris and Target Material

May 2006

LOADS Processing

Lightweight Ordnance & Armaments Demilitarization System

Designed, Engineered, and Manufactured

for

Range-Related Debris Processing

- ✓ Provides for certification, separating & grading
- ✓ Capable of processing efficiently
- ✓ Risk Reduction - 100% initial inspection and 100% QC verification and certification after processing
- ✓ Mobile... go to the problem

LOADS Technology

Designed for Range-Related Debris Processing

Mobilization Cost Low, Maintenance Low, Salvage $ Return High

May 2006

Systems – LOADS Processing Equipment

The UXB LOADS Systems

- **LOADS-LB** – Large Breaker Assembly
  - Processes multiple munitions
  - 40mm to 5 inch munitions
- **LOADS-MB** & **WMB-Mini-Breaker** Assemblies
  - Processes multiple munitions
  - firearms, 20mm and 2-6 inch munitions
- **LOADS-HC (shear)** – Hard Case Bomb Assembly
  - Processes 180 – 200 Mk Series style practice bombs day
  - Under development (4-18 inch munitions)

LOADS System (History)

LOADS-LB (Processing BDU-33's)

LOADS-LB (Three to Four Person Effort)

LOADS-LB (Graded Metals Separated for Maximum Value)

LOADS-LB (Fuze Processing)

LOADS-LB (Fuze Processing)

LOADS-LB (Fuze Processing)

LOADS Processing

Range-Related Debris , removal, processing, disposal

Range-Related Debris Processing

LOADS Processing

Range-Related Debris , removal, processing, disposal

Ordnance Debris After Processing

LOADS-LB (Range-Related Debris)

LOADS-LB (Range-Related Debris Processing)

LOADS-LB (Range-Related Debris Processing)

LOADS-LB (Range-Related Debris Processing)

LOADS-MB / WMB (Range-Related Debris Processing)

LOADS-MB & WMB (Range-Related Debris Processing)

LOADS-MB & WMB (Range-Related Debris Processing)

Practice Bombs Processed and Certified!
0 % RISK TO PUBLIC

500 lb GP training Bomb – Current method

Portable Shear

500 lb. GP training bomb

Additional Support Equipment

- Portable Shear
- Portable Shredder
- Heavy Equipment
- Plasma Arc Torches
- Oxy/Acetylene & Propane Torches
- Tractor Trailers (Transporters)
- Containers

Summary

- ✓High Capacity, 30 + ton day
- ✓Machines Designed for Training Munitions
- ✓Totally Self-Contained
- ✓Allows 100% Initial Inspection & Re-inspection
- ✓Firm Fixed Price Bids

Questions

Contact Information

UXB International, Inc.

www.uxb.com

U.S. ARMY RESEARCH, DEVELOPMENT, AND ENGINEERING COMMAND

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

AMC

CRYOFRACTURE DEMILITARIZATION PROGRAM UPDATE

PRESENTED BY:

Florence Elie-Delacruz
Armament Engineering and Technology Center
Energetics, Warheads, and Environmental Technology Directorate

John F. Follin
General Atomics
San Diego , CA

2006 Global Demilitarization Symposium & Exhibition
Indianapolis, Indiana
May 4, 2006

GENERAL ATOMICS

Committed to Excellence

ACKNOWLEDGEMENTS

- **Project Sponsors:**
  - » Product Manager for Demilitarization
  - » US Army Defense Ammunition Center

- **Project Team:**
  - » PM Demil - Project Oversight
  - » DAC – Project Integration and Coordination
    – Robotics Integration
  - » ARDEC – Project Execution and Technical Supervision
  - » MCAAP – Facility Support and Process Operations
  - » GA – Process Design, Construction/Installation, and Proveout

PRESENTATION OUTLINE

- **Background**
- **Project History**
- **Prototype Facility**
  - » Process Design Basis
  - » Facility Development
  - » Procurement/Construction Status
  - » Schedule
  - » Summary

BACKGROUND

- There is a potential requirement to demilitarize 6 to 9 million ADAM antipersonnel landmines as well as a variety of other small explosive loaded munitions in the demil inventory (e.g., grenades, mines and submunitions in ICMs and CBUs)
- Conventional methods are not acceptable for the ADAM mine:
  - » Components include explosives (in the overlay/kill mechanism, gas generator, Safe & Arming Device), an ammonia battery and an epoxy housing containing a small amount of DU
  - » OB/OD yields DU/explosives mixed waste which contaminates the soil, air and water and is not exempted under Federal Regulation 10CFR40
  - » Disposal sites will require long-term care, monitoring and maintenance to protect the public health and safety
  - » Incineration in a deactivation furnace will result in contamination of the furnace and ultimately require its disposal
- For other small explosive-loaded munitions, there is a hazard associated with detonation in the furnace.

OBJECTIVE

- Develop a safe, cost effective, environmentally sound technology for the demilitarization of the ADAM mine and other small, explosive-loaded munitions in order to:
  - » Phase out Open Burning/Open Detonation
  - » Increase the throughput in deactivation furnaces
  - » Minimize risk to personnel and equipment
  - » Reduce operator exposure to DU/explosive materials during the demilitarization operation
  - » Demonstrate automated projectile download operations

TECHNICAL APPROACH

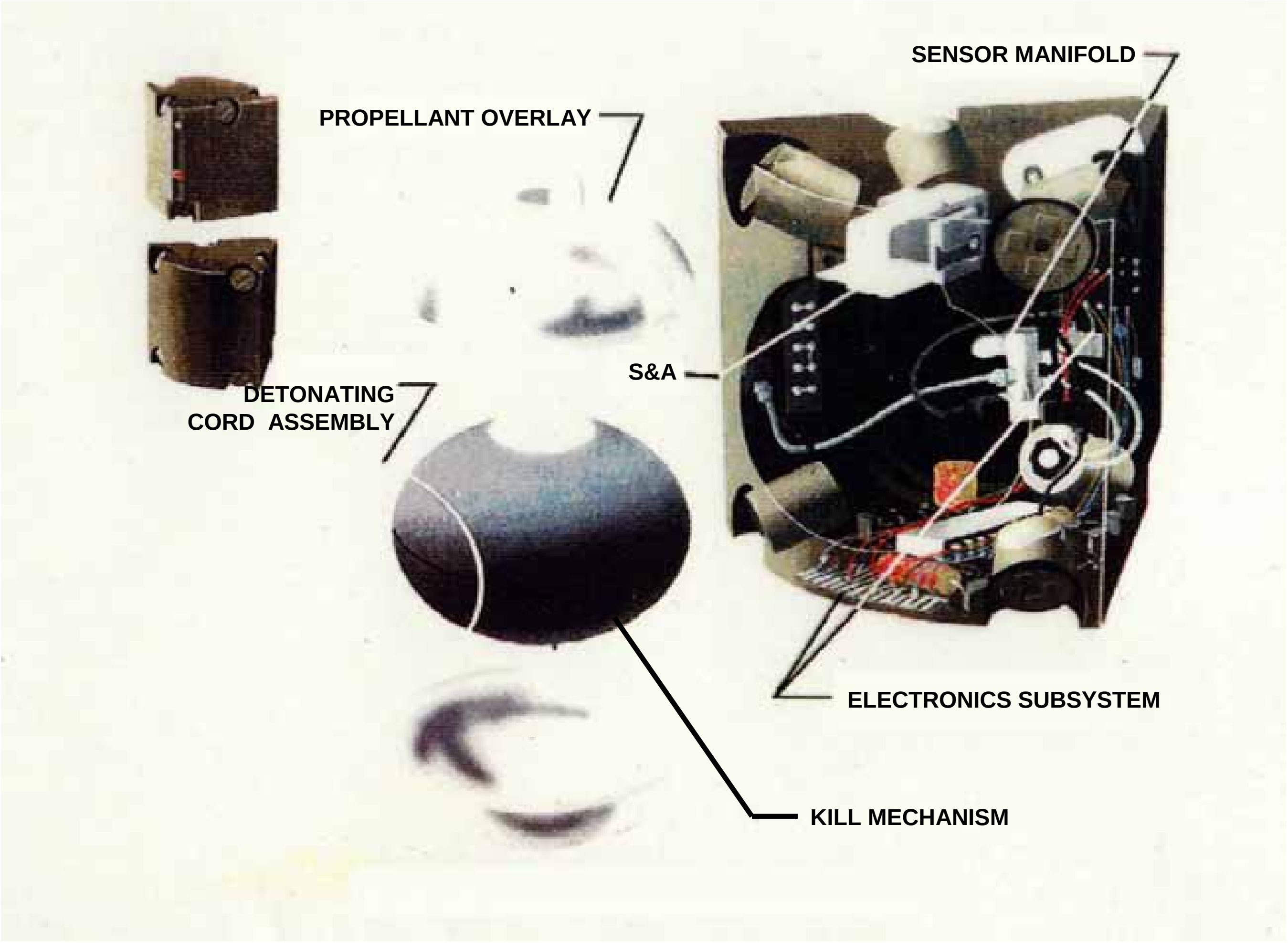
- Use an existing large-scale cryofracture test facility at Dugway Proving Ground (DPG) to determine feasibility of process and confirm the proposed prototype design

- Design, procure, install and proveout a high rate prototype cryofracture demil facility at McAlester Army Ammunition Plant (MCAAP), Oklahoma

CRYOFRACTURE PROJECT HISTORY

- **Project has evolved through 5 phases**
- **Phase I: Proof of Principle for Conventional Ammunition**
  - » 1994-1999: Inert and live testing of various munitions at DPG
  - » 1997: ADAM mine selected as primary candidate item
- **Phase II: Design of Prototype Facility at McAlester AAP**
  - » 1997: Cryofracture process conceptual design completed
  - » 1999: Detailed process design completed
  - » 2000: Building and support equipment design completed
- **Phase III: Facility Construction and Equipment Procurement/Fabrication/Installation/Proveout and Manual Demonstration/Validation**
  - » 2000-2004
- **Phase IV: Addition of Automated Robotically-Based Projectile Disassembly/Downloading Capability**
  - » 2001-2005
- **Phase V: Process Equipment and Safety Upgrades/Integrated (including robotics) Dem/Val**
  - » 2004-Present

Area Denial Artillery Munition (ADAM) Mine



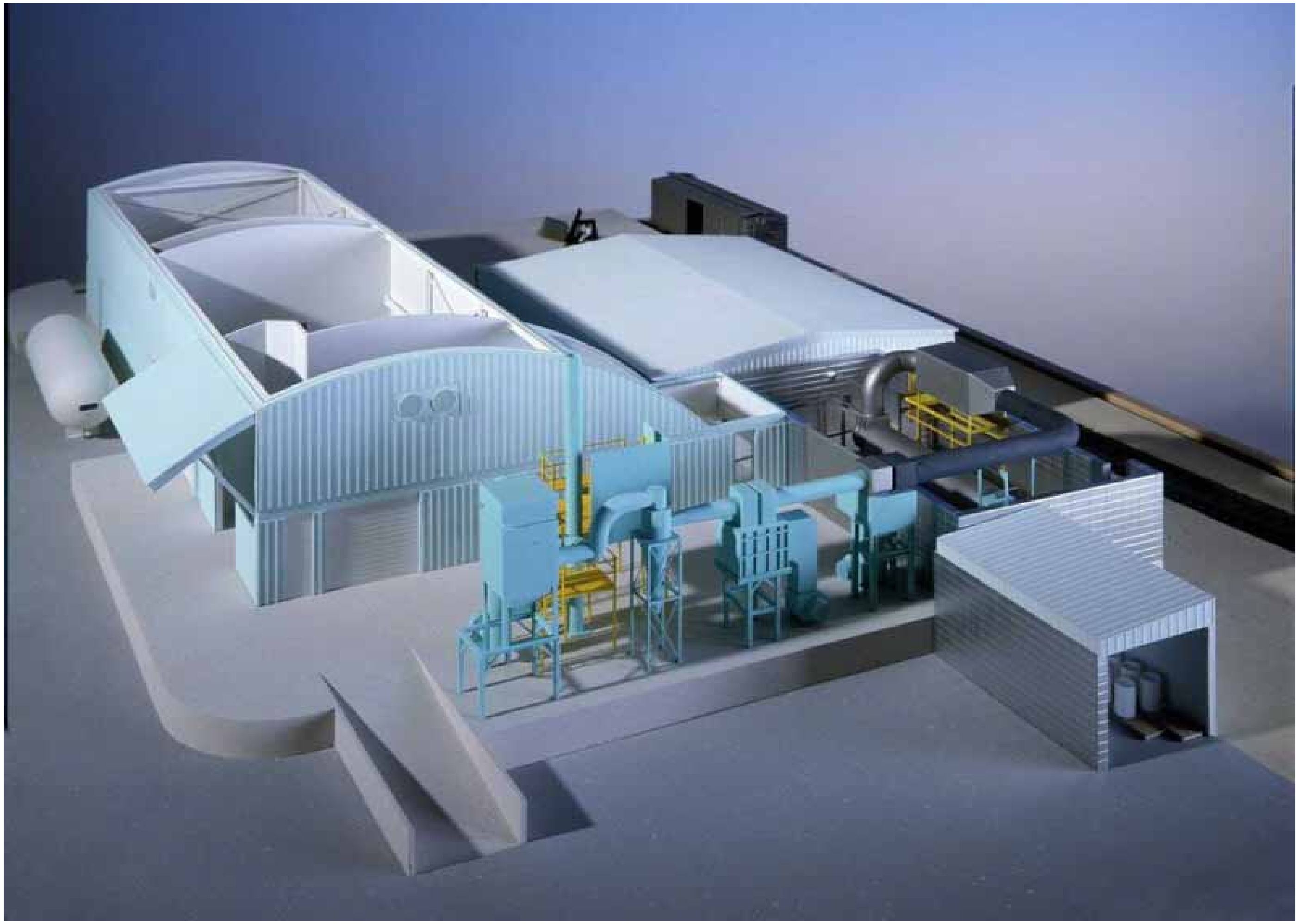
MCAAP MCDF Development Cryofracture Process Design Basis

- **Process ADAM mines**
- **Process other munitions tested at DPG or at YPG**
- **Process other “yet-to-be identified” munitions**
- **Throughput is one fracture per minute**
- **Each fracture processes multiple munitions**
- **Interface with existing APE-1236 Deactivation Furnace**

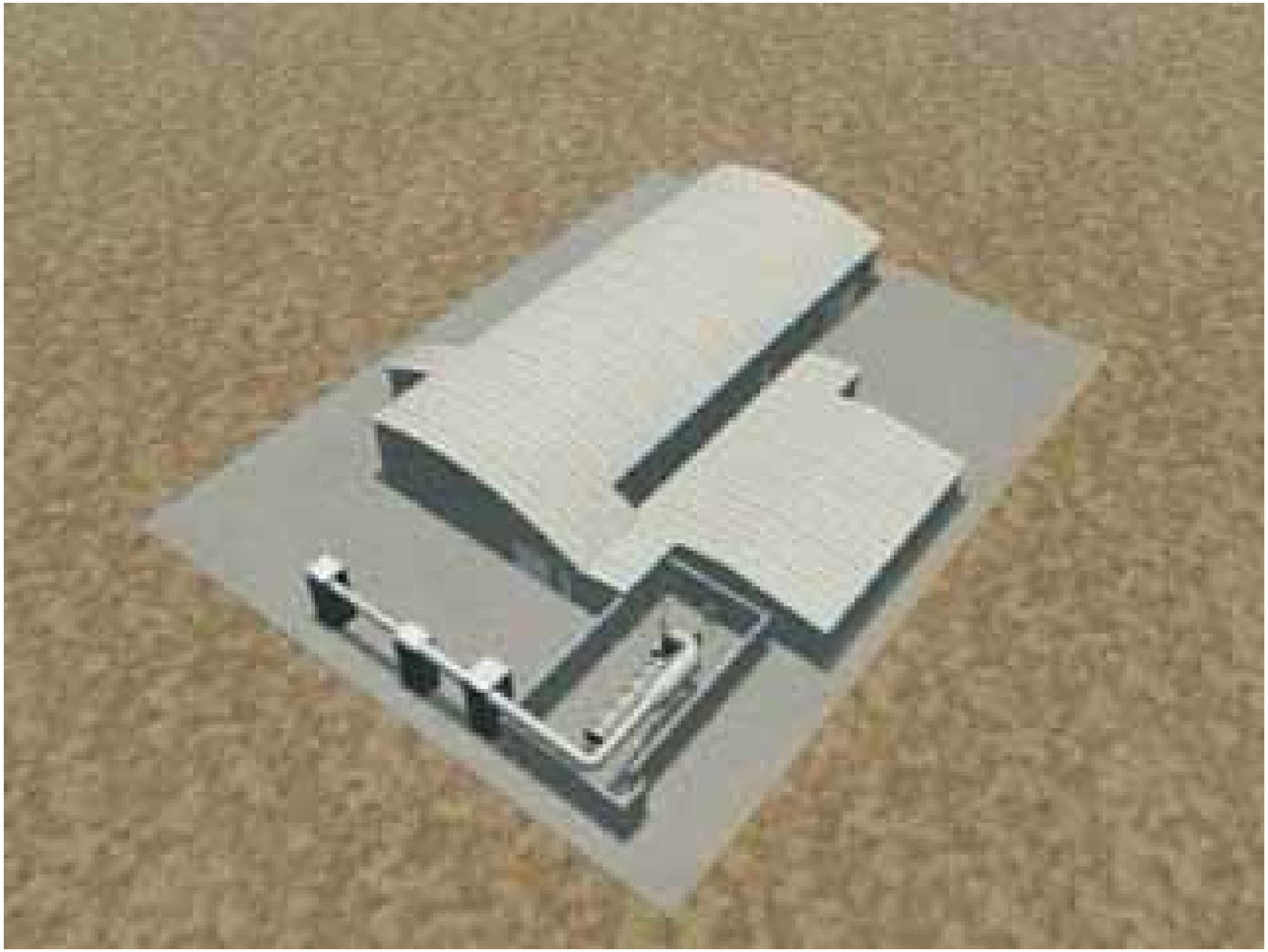
MCAAP MCDF Development Projectile Download Design Basis

- Accept fully loaded M732 and M692 projectiles containing 36 ADAM mines
- Remove the ADAM mines from the projectiles
- Collect/segregate all scrap material (metal projectile, spacers, projectile base plate, ogive, pushout rod, etc.)
- Place the ADAM mines in cryofracture transport fixtures for introduction to the cryofracture process

MCAAP Cryofracture Facility



Cryofracture Demilitarization Facility Animation Video



Loading ADAM Mines on Conveyor

ADAM Mines Cooling in Cryobath

ADAM Mines Ready for Cryofracture

ADAM Mines after Cryofracture

Cryofractured Overlay Kill/Mechanisms

RKS Feed of Accessed O/KMs

Deactivation by Induction Heating

ADAM Mine Debris in Drum

Control Room Workstations

MCAAP MCDF DEVELOPMENT
Past Milestones

Jun 04 **Validation testing nearly complete (w/o PDWC) √**

- **Plant fully operational at full rate (9300 mines)**
- **Test terminated due to explosive mishap**
- **Minimum damage ($5k) – surrounding equipment and building okay – no injuries**

Sep 05 **Performed process safety assessment and equipment reconfiguration plan and design √**

Oct 05 **Performed TVT to verify O/KM accessing √**

Mar 06 **Final Equipment Improvement Design √**

- **Press tooling and fragmentation shields**
- **O/KM and debris discharge chutes**
- **Blast isolation valves**
- **Dust Collection System**

Tooling Verification Test

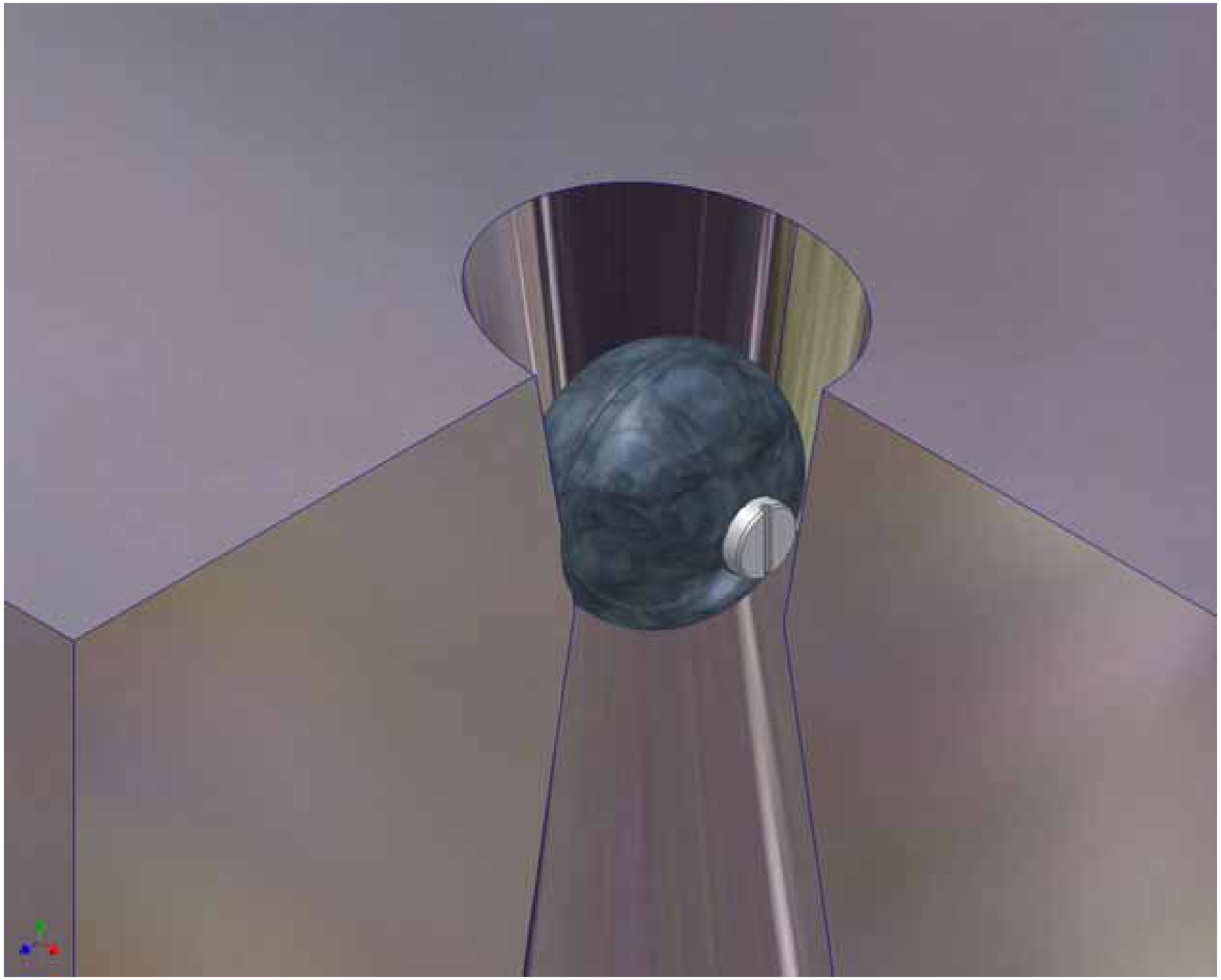
- **Test to Identify Cryofracture Tooling for**

  - Proper O/KM Accessing
  - Elimination of high-order detonation in RKS
  - Proper O/KM Debris Discharge
  - Proper Breakup of the ADAM Mine Housing for Energetic Deactivation by Induction Heating

  - Perform additional MCAAP industrial health monitoring and measurement

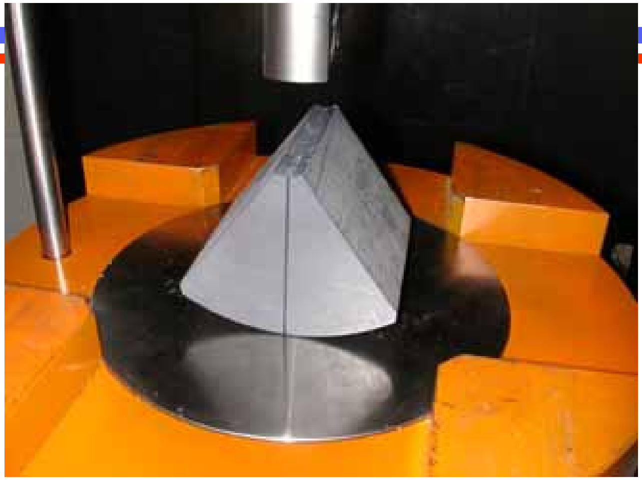
- **Tests were performed in Oct 2005 and were successful**

New O/KM Accessing Method



O/KM Accessing TVT at MCAAP

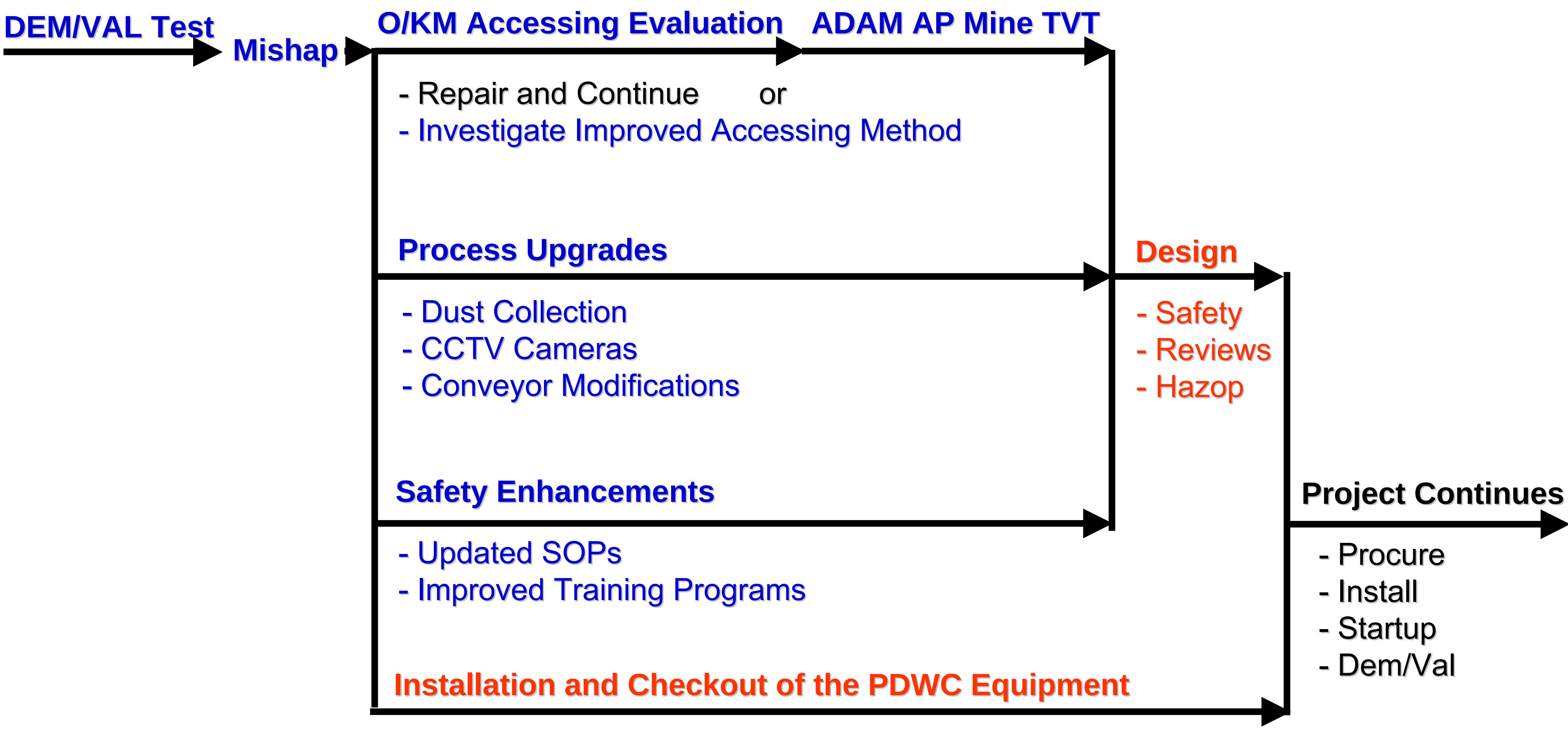
O/KM Accessing TVT at MCAAP



MCDF Munitions Processed To-Date

- 958 Simulants (plastic inerts)
- 1,832 Previously functioned ADAM QA mines from YPG
- 2,655 ADAM QA mines
- 9,384 ADAM AP mines

Short-Term Path Forward



MCAAP MCDF DEVELOPMENT
Future Milestones

May 06	**HAZOP and Process Review**
Jun 06	**PDWC Installation/Checkout/Testing Complete**
Jul 06	**Procure Safety and Upgrade Equipment for Cryofracture**
Aug 06	**Equipment Installation**
Oct 06	**Integrated Installation/Checkout/Startup complete**
Nov 06	**MCAAP Training Program (on-going) complete**
Dec 06	**Dem/Val Testing Complete (MCDF and PDWC)**
Feb 07	**Transition to Support ADAM mine demil workload**

SUMMARY

- Cryofracture technology has been shown to be an effective means for demilitarizing a variety of small explosive-loaded conventional munitions
- Cryofracture provides a solution to the ADAM mine mixed waste demilitarization problem
- Automated robotic process will demonstrate an effective means for disassembling/downloading cargo-carrying 155mm projectiles
- The SEAS press incident, while disappointing and impacting the schedule, has led to operational and safety improvements
- Development of a prototype facility will provide a safe, cost effective and environmentally sound alternative to OB/OD and significantly enhance deactivation furnace processing

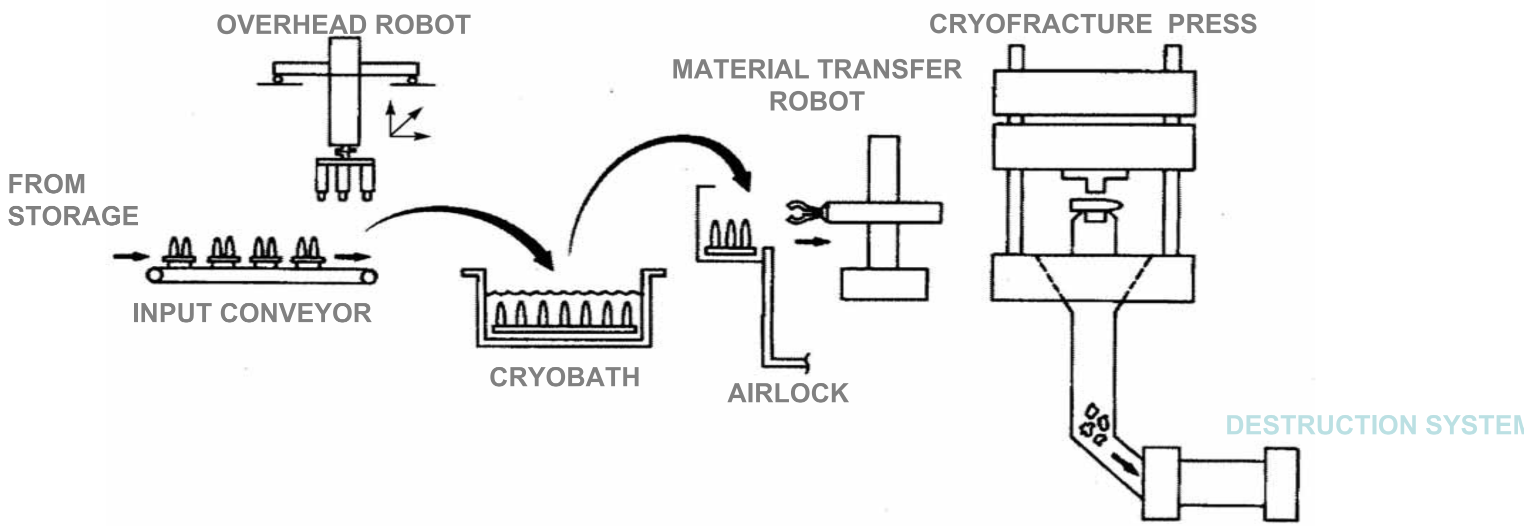
The Cryofracture Demilitarization Process:

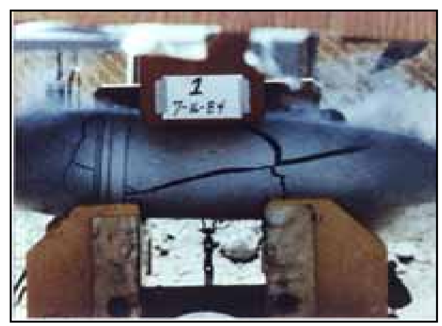
An Evolving Technology

John Follin
General Atomics

2006 Global Demilitarization Symposium & Exhibition
Indianapolis, Indiana
May 4, 2006

MUNITION CRYOFRACTURE PROCESS





DESTROYS MUNITIONS EFFICIENTLY AND THOROUGHLY

CRYOFRACTURE ATTRACTIVE CHARACTERISTICS

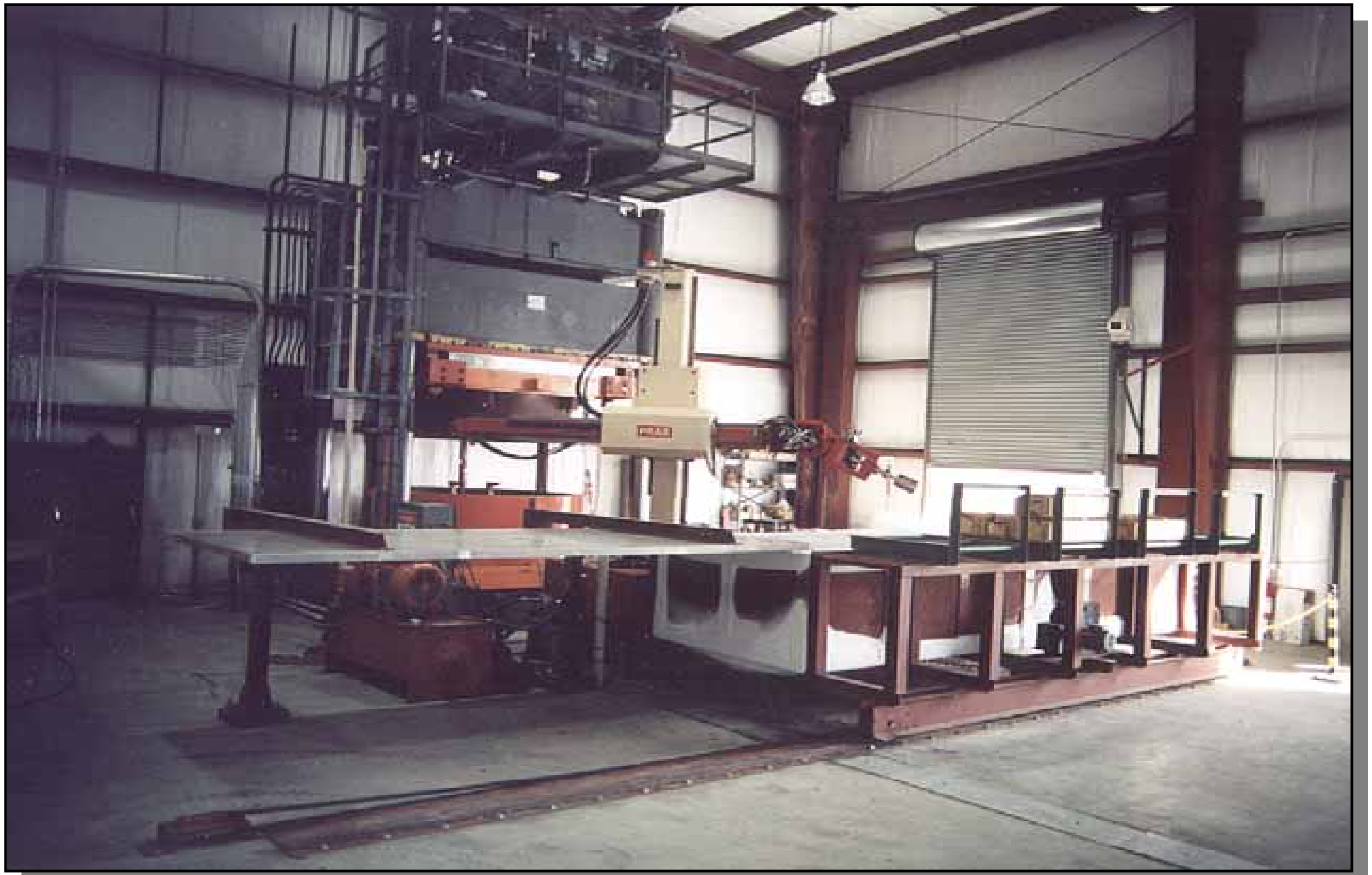
- **Cools munitions in liquid nitrogen prior to fracture in a hydraulic press**
- **All munition handling performed by remotely controlled robots or automated conveyors (manual item feed)**
- **Minimum contaminated area (contained within the equipment)**
- **Simple system processes all munitions**
- **Completely destroys the munition**
- **Flexible process is not sensitive to detail design or condition (range from new to poor condition)**
- **High throughput/competitive cost**
- **Interfaces with all types of incineration systems (APE-1236, APE-2210, Plasma Arc, SCWO, etc.)**

Dugway Proving Ground

Cryofracture Test Facility

Sponsored by ARDEC

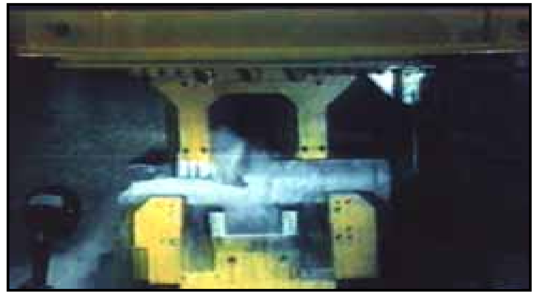
DPG Munitions Cryofracture Test Facility



Processed over 4000 items – Small ICMs to 8 inch Projectiles

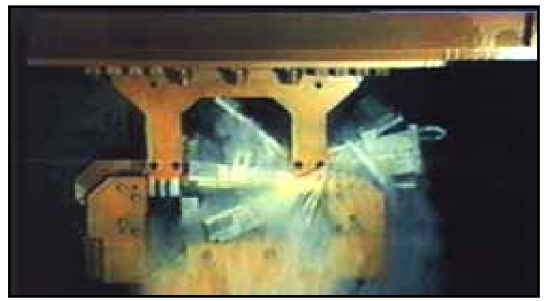
CRYOFRACTURE DEMONSTRATED FOR LARGE MUNITIONS


BOXED 105 mm CARTRIDGES


OVERPACKED MUNITIONS


155 mm PROJECTILES


DRUMMED MINES


4.2 IN. MORTARS


ROCKETS


8 IN. PROJECTILES

OVER 4000 EXPLOSIVELY CONFIGURED MUNITIONS SUCCESSFULLY CRYOFRACTURED

CRYOFRACTURE COMPLETELY BREAKS UP MUNITION ITEM

4.2 IN. MORTARS

155 mm PROJECTILES

BOXED 4.2 IN., MORTARS

105 mm PROJECTILES

DRUMMED MINES

ROCKETS

CRYOFRACTURE ALSO DESTROYS MUNITION BODIES

DPG SMALL ITEM CRYOFRACTURE

ADAM AP Mines

Rockeye II Bomblets

M16A1 AP Mines

McAlester Army Ammunition Plant

Sponsored by PM-Demil, ARDEC and DAC

Supported by MCAAP

MCAAP Munitions Cryofracture Demilitarization Facility

Munition Feed (manual or automatic)

Munition immersion in LN2

Automatic placement in press

Munition Cryofracture

Debris discharge in RKS

Remote/Automatic Control

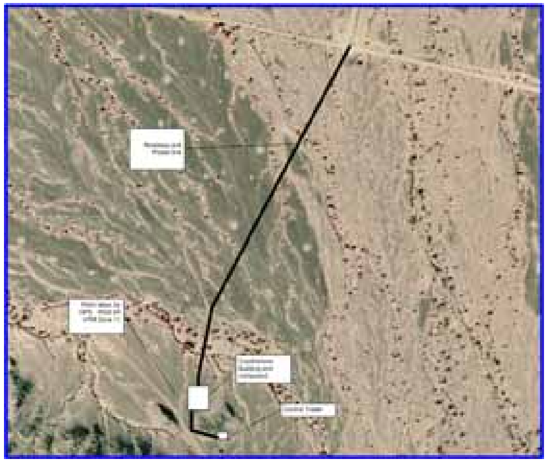
Processed 14,705 items – Design upgrades with plant restart planned for Fall 2006

Yuma Proving Ground

Munitions Cryofracture Facility

Sponsored by YPG

YPG Munitions Cryofracture Facility



Site at KOFA Firing Range

Building, LN2 Tank, Control Room

Munitions unload/load station

Munition immersion in LN2

Munitions to be fractured in press

Munitions fractured in press

Plant to process ICMs – Later 155mm Projectiles – Startup planned in May 2006

Yuma Proving Ground

Tooling Verification Test Facility

Sponsored by PM-Demil, ARDEC and DAC

Supported by YPG

YPG Remote TVT Site for R&D

Outdoor (covered) test site

Control Room behind berm

Remote cryofracture tests

Liquid Nitrogen Cryobath

Cryofracture Tooling

Energetic Burn Pans

TVT tested 10 different unique munition items in March/April for Cryofracture

Items Tested at the YPG TVT

M406 and
M433 40mm
HEDP

M379 Fuze

M26 Hand
Grenade

CBU 58/B (E803) BLU 63/B Download

BLU Items Tested at the YPG TVT

**BLU 63/B
(CBU 58/B)**


**BLU 86/B
(CBU 71/B)**

**BLU 61A/B
(CBU 51B/B)**


Transportable Cryofracture System

Sponsored by PM-Demil, ARDEC and DAC

Transportable Cryofracture Project

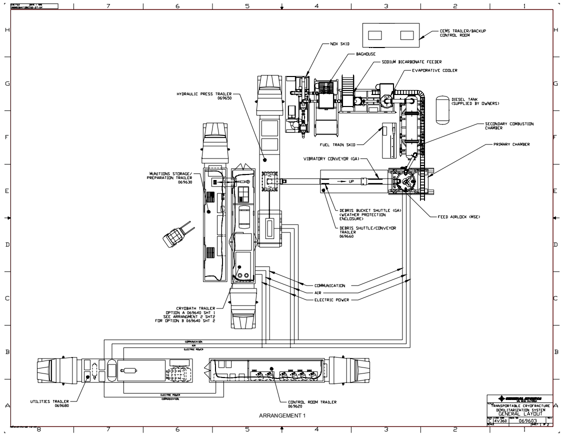
- Seven trucks containing equipment to support remote and automatic cryofracture operations

- System, with diesel fuel, self sufficient (electricity, liquid nitrogen, process air, etc.)

- System designed for a wide variety of munition feed
  - ICMs, CBUs, small projectiles, hand grenades
  - Destructor assemblies, burster tubes
  - Other medium/small energetic/explosive items

- System designed for a variety of incineration feeds
  - Plasma Arc
  - APE-1236 and APE-2210 Rotary Kiln Systems
  - High-throughput Thermal Treatment Systems

Transportable Munitions Cryofracture Plant



Equipment mounted in trailers

Transportable cryofracture system

Plasma Arc thermal treatment system

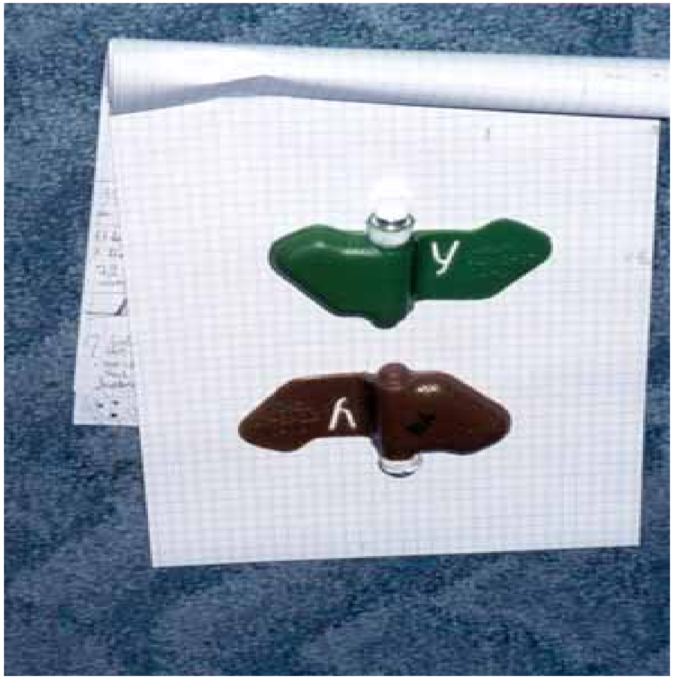
Plant village can be located anywhere

Detail design underway with procurement and truck/trailer assembly next year

Future Projects

- Cryofracture Projects in Europe
- Transportable cryofracture in Europe
- Ukrainian PFM-1 mine demil

Destruction of PFM-1 Stockpile in Ukraine



Individual PFM-1 Mines

PFM-1 mines in Aluminum Casing

Summary – Cryofracture Item Data Base

- **Large Items**
  - 8 inch, 155mm, and 105mm Projectiles
  - M23 landmines, M55 Rockets (115mm), and 4.2 in. mortars
- **Medium/Small Items**
  - ADAM mines, Rockeye II (MK 118), ICMs (M42, M46, M77)
  - Hand grenades (M69, M67, M61), M16 mines
- **New Items**
  - BLUs (BLU 63/B, BLU 86/B, BLU 61)
  - 40mm Cartridge Rounds (M406, M433)
  - Destructors (M10, M4, MK24)
  - Fuzes (M379)
  - Hand Grenades (M26)

SUMMARY

- Cryofracture technology has been shown to be an effective means for demilitarizing munitions instead of OB/OD
- The cryofracture process can handle a wide range of munitions – limiting factor is the thermal treatment process
- Process can be simple → cryocool, cryofracture, discharge, incinerate, and recycle
- Process can be complex → cryocool, cryofracture, segregate waste streams, incinerate and/or drum, and recycle
- Cryofracture technology is evolving
  - Some sites are in the implementation/test phase
  - Test site is expanding cryofracture munition data base

U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)

TESTING AND OPTIMIZATION OF A MOBILE PLASMA TREATMENT SYSTEM (MPTS)

Presented by:
Mr. Francis Sullivan

Armaments Engineering and Technology Center
Energetics, Warheads, and Environmental Technology Directorate
Picatinny Arsenal, NJ

NDIA 2006 Global Demilitarization Symposium & Exhibition
Indianapolis, IN
1 – 5 May 2006

Presentation Outline

- Program Objective
- Plasma Technology Overview
- MPTS System Description
- Process Enhancement and Optimization Efforts
- Demonstration/Validation Testing
- Recent Accomplishments
- Summary

Program Objective

- To develop and implement a transportable, environmentally sound technology for the demilitarization of conventional munitions for which open burning/open detonation is not permitted, conventional incineration is not viable, R^3 is not feasible, or no other technology exists.

Background

- DOD Reducing Dependence on OB/OD
- Problems Have Been Reported with Existing Incinerators in the Demilitarization of Certain Munitions
  - Heat damage, fugitive emissions, particulate filters clogging, incomplete destruction of items
  - Incinerator ash has been classified as a hazardous waste
- Plasma Arc Technology Addresses Many of These Problems
  - High temperature thermal destruction of organic materials; more uniform and reliable DRE
  - Smaller volume of process gases; no fugitive emissions
  - No hazardous waste; non-hazardous slag or recyclable metal instead
- Transportable Capability Offers Additional Benefits
  - Packaging and transportation costs for munitions eliminated through bringing system to treatment site
  - Simplified permitting can be achieved in some instances

MPTS Representative Potential Feedstock

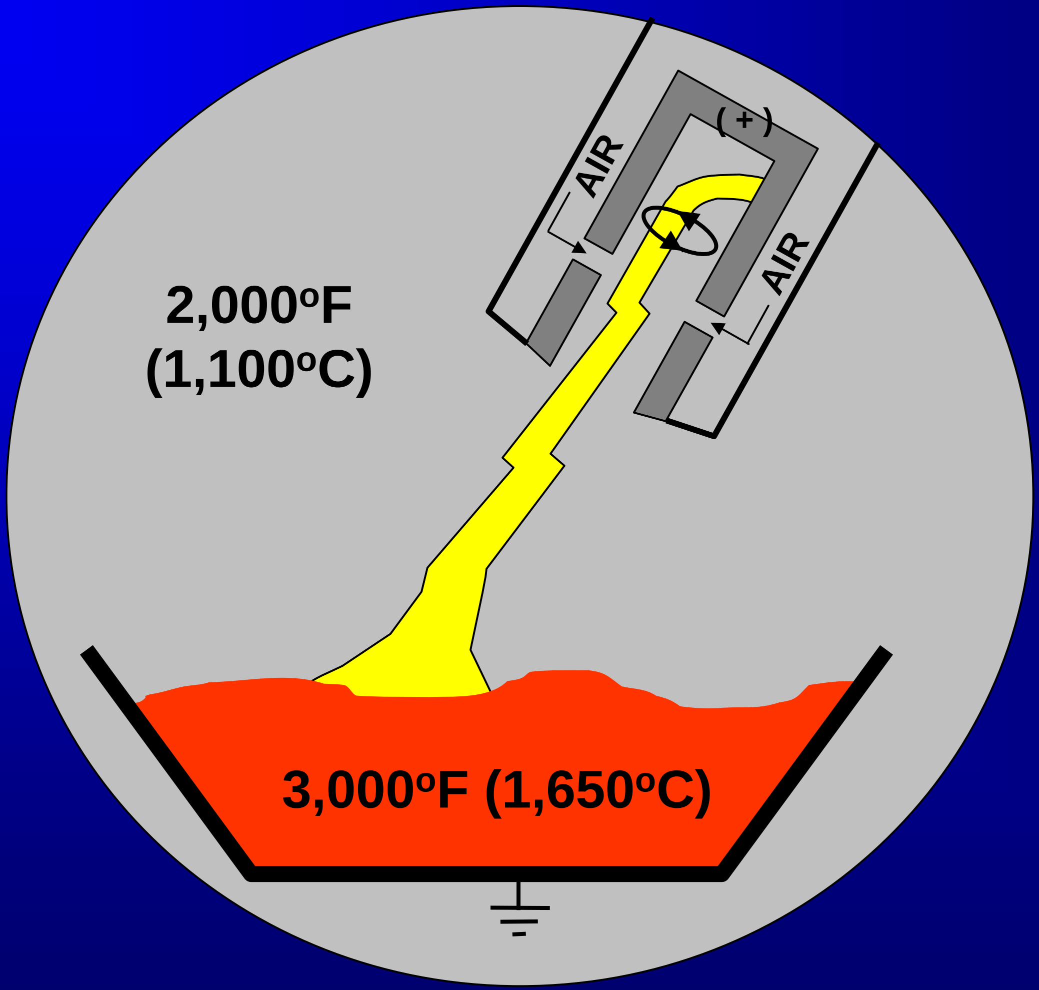
Oxidizing Mode

Reducing Mode

Other Candidate Items

- Riot Control, Incendiary, and Phosphorous Items
- Fuzes and Fuze Components
- Pyrotechnic Items With Rocket Motors
- Propellant & Cartridge Increments
- Cartridge Activated Devices (CADs) & Propellant Activated Devices (PADs)
- Small High Explosive Items (<0.35 lbs. NEW)
- By-products of R^3 Processes

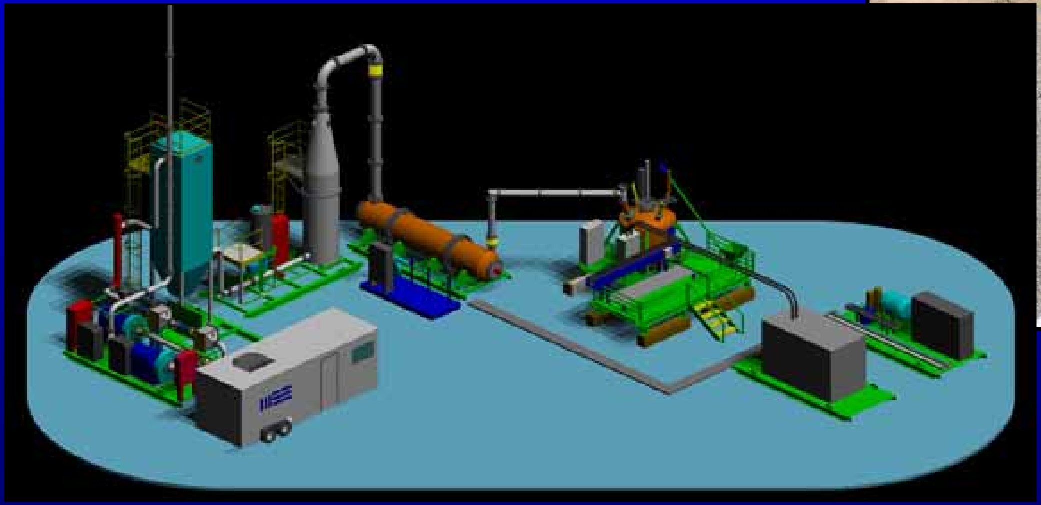
Transferred Arc Torch Operation



Mobile Plasma Treatment System (MPTS)

Installed System

Conceptual Layout



MPTS Process Description

- **Three Primary Subsystems**
  - **Feed System**
  - **Primary Chamber/Plasma Torch**
  - **Pollution Control and Monitoring System**
- **Coordinated through Central Control Trailer**

Feed System

- **Key features**
  - Ordnance feeder consists of pocketed conveyor belt that dumps ordnance through a series of knife valves into a feed tube, where it is forced into the plasma chamber vessel by a pneumatically actuated rammer
  - Soil and flux are fed into the top of the primary chamber through a valve using a flexible screw conveyor and hopper (not pictured)
  - Transportable, fully integrated feed room

Primary Chamber

- **Key features**
  - Water-cooled chamber
  - 500-kW plasma torch for complete destruction of organic materials and melting of inorganic materials
  - Oxidizing or reducing environment; capability of supplemental O_2, air, or nitrogen (N_2)
  - Oxy-lance burning bar for slag tapping

Pollution Control and Monitoring System

- **Key features**
  - Secondary Combustion Chamber
  - Evaporative Cooler and Dry Scrubber
  - Catalytic NO_x Removal
  - Continuous Emissions Monitoring System (CEMS)

Process Enhancements and Optimization Efforts

- **Objectives Met:**
  - System has been characterized through testing with several different types of munitions in both oxidizing a reducing PPC environments.
  - Enhancements were made to improve system performance and increase overall versatility.

Demonstration/Validation (Dem/Val) Testing

- **Extended Dem/Val Testing is being conducted at Talon Manufacturing Company (TMC)**
  - **Site Preparation and Mobility Assessment (completed)**
    - Site prepared and MPTS transported to TMC and installed
  - **Environmental Compliance Verification (completed)**
    - Demonstrated reducing-mode operation within requirements of environmental regulations
  - **Dem/Val Testing and Extended System Characterization**
    - Process TMC's inventory of fuzes, under a reducing environment, to recover metal and demonstrate effectiveness of system modifications
    - Document system performance in metals recovery operations and evaluate utility of the MPTS for use in other short term remediation campaigns
    - Completed first three Dem/Val campaigns with fuzes from TMC stockpile

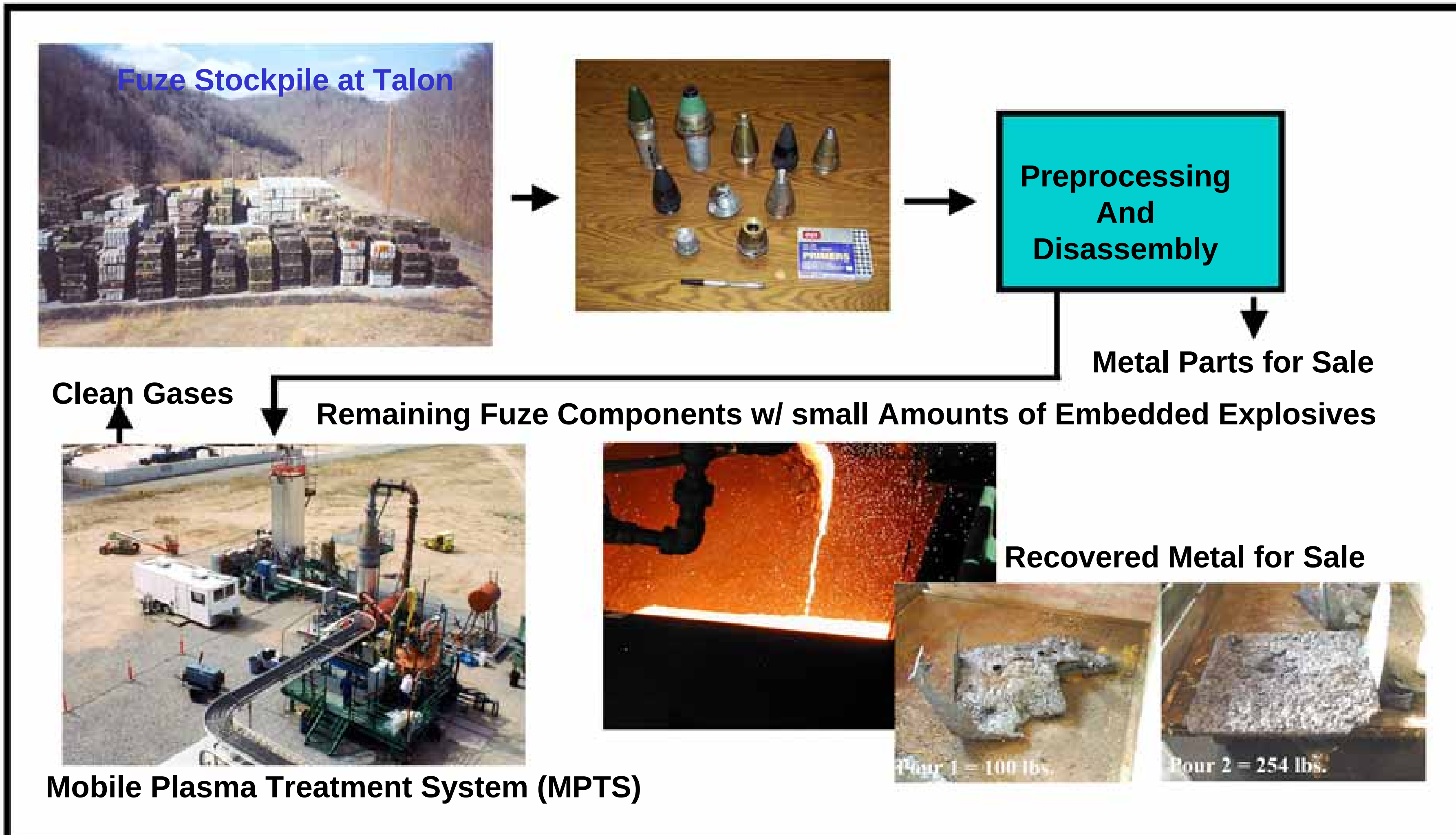
Dem/Val Feed Material

FUZE COMPONENT INVENTORY		
ITEM/COMPONENT	**QTY**	**NEW/EA**
M565 BODIES	672	0.001
M557 BODIES	142588	0.001
MK27 DETS	316000	0.0001
M501 DETS	5280	0.001
M521 DELAYS	23040	0.001
M501 BODIES	169644	0.001
M524 LEADS	342000	0.001
M525 BODIES	271296	0.0028
M739 BODIES	158017	0.001
M572 BODIES	54268	0.001
M8 BODIES	80000	0.001
M532 ELEC DETS	610120	0.0005
M501 NOSE DETS	59400	
M513 BODIES	304785	0.005
MK90 BODIES	20200	0.001

Dem/Val Testing Objectives

- **Validate System Design Enhancements**
  - Test performance of system with structurally enhanced primary chamber and integrated system utilities
- **Characterize/Optimize Performance of MPTS in Metals Recovery Operations**
  - Demonstrate extended performance capability and robustness of system
  - Identify process characteristics associated with metals recovery operations
- **Added Benefit: Help West Virginia Department of Environmental Protection to Solve a Highly Visible Waste Disposal Problem**

TMC Dem/Val Material Flowchart



Installation and Startup Testing

- **Objectives:**
  - Install MPTS at TMC
  - Integrate all new system equipment
  - Develop testing procedures
  - Validate reducing mode processing characteristics
  - Interface supporting operations

Installed System at TMC

Dem/Val Testing Status

- **Completed first three Dem/Val Campaigns during April 05 - June 05**
  - Campaign consisted of MK27 Rotors/Housings and M564/565 Fuzes
- **Plans developed to enhance system and perform additional Dem/Val campaigns**
  - Modify system and validate process enhancements
  - Process additional items from the TMC fuze stockpile.
  - Determine most cost-effective method for processing remainder of TMC fuze stockpile.

Future Milestones

- FY06-FY07 (Depending on Availability of Funding)
  - Implement process upgrades based on lessons learned
  - Recertify MPTS CEMS
  - Conduct stack testing to certify MPTS for operation in either oxidizing mode or reducing mode (PPC environment)
  - Perform additional R&D Dem/Val campaigns to characterize system performance
  - Transition to production mode operations to process remainder of TMC fuze stockpile

Summary

- A Mobile Plasma Treatment System has been designed, built, tested, enhanced, and evaluated. The system will provide the U.S. Army with the following unique demilitarization capabilities beyond those of Open Burning/Open Detonation and Conventional Incineration:
  - **Mobile capability to address a variety of site-specific demilitarization requirements**
  - **Safe, environmentally compliant process with non-hazardous slag or metal product; Dual modes of operation (oxidizing and reducing)**
  - **More thorough and reliable destruction of organic and energetic constituents when processing many types of munitions**
  - **Capability to treat a wide variety of small, fully assembled munitions and components**
- The MPTS has been installed at TMC and an extended test program is presently underway

U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

PLASMA ORDNANCE DEMILITARIZATION SYSTEM (PODS)

FOR THE DESTRUCTION OF PYROTECHNIC ORDNANCE

Presented by:
Dan Flynn

Energetics, Warheads, & Environmental Technology Directorate
Producibility for Production Readiness Division
Picatinny, NJ

2006 Global Demilitarization Symposium & Exhibition
Indianapolis, IN
1-4 May 2006

PRESENTATION OUTLINE

- Program Objective
- Background
- PODS System Description
- Project Status
- Testing Overview
- Program Schedule
- Items to be Processed
- Operating Cost Estimate
- Summary

PROGRAM OBJECTIVE

To develop an alternative method of demilitarization for small, fully assembled, smoke and pyrotechnic ordnance - a task which had previously been accomplished by Open Burning/Open Detonation (OB/OD) and conventional incineration.

BACKGROUND

- The Surgeon General Imposed a Moratorium on OB/OD of Smoke and Dye Munitions
- Problems Have Been Reported with the Use of Existing Incinerators for the Demilitarization of Smoke and Pyrotechnic Items
  - Heat damage to incinerators from flares
  - Filters clogging with particulate matter
  - Incinerator ash has been classified as a hazardous waste
  - Fugitive emissions
- In general, the DOD is Reducing Dependence on OB/OD and is Increasing the Use of Closed Disposal Technologies (CDT), Including R3

BACKGROUND (cont.)

- Plasma Arc Technology Offers Several Advantages Over Traditional Incineration:
  - Non-hazardous solid slag output instead of hazardous ash
  - Clean gaseous effluents at lower mass flows
  - No fugitive emissions
  - Capability to demilitarize the assembled end item without furnace damage
  - More uniform and reliable DRE

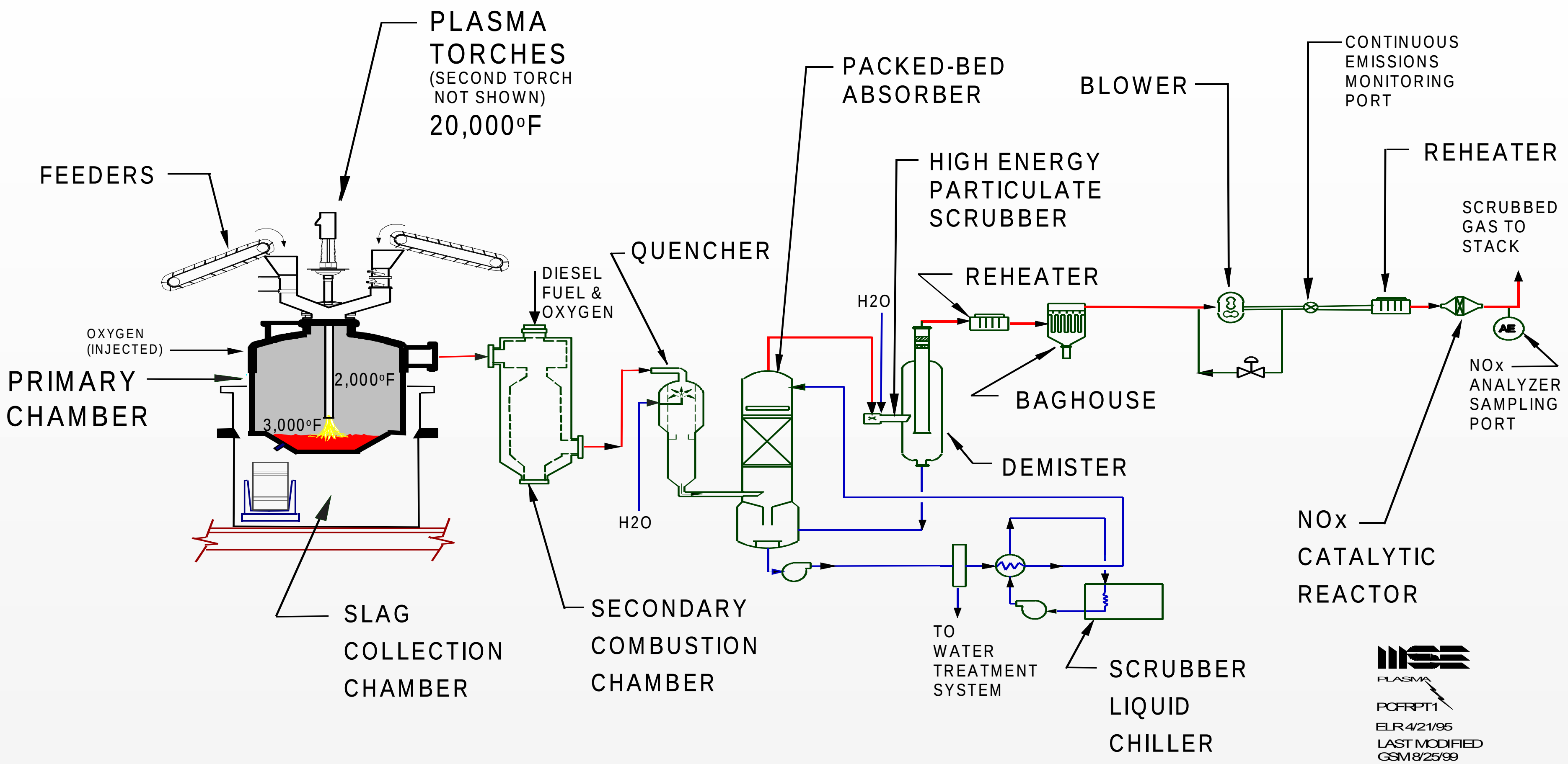
CANDIDATE ITEMS

Major Focus: Pyrotechnic Items

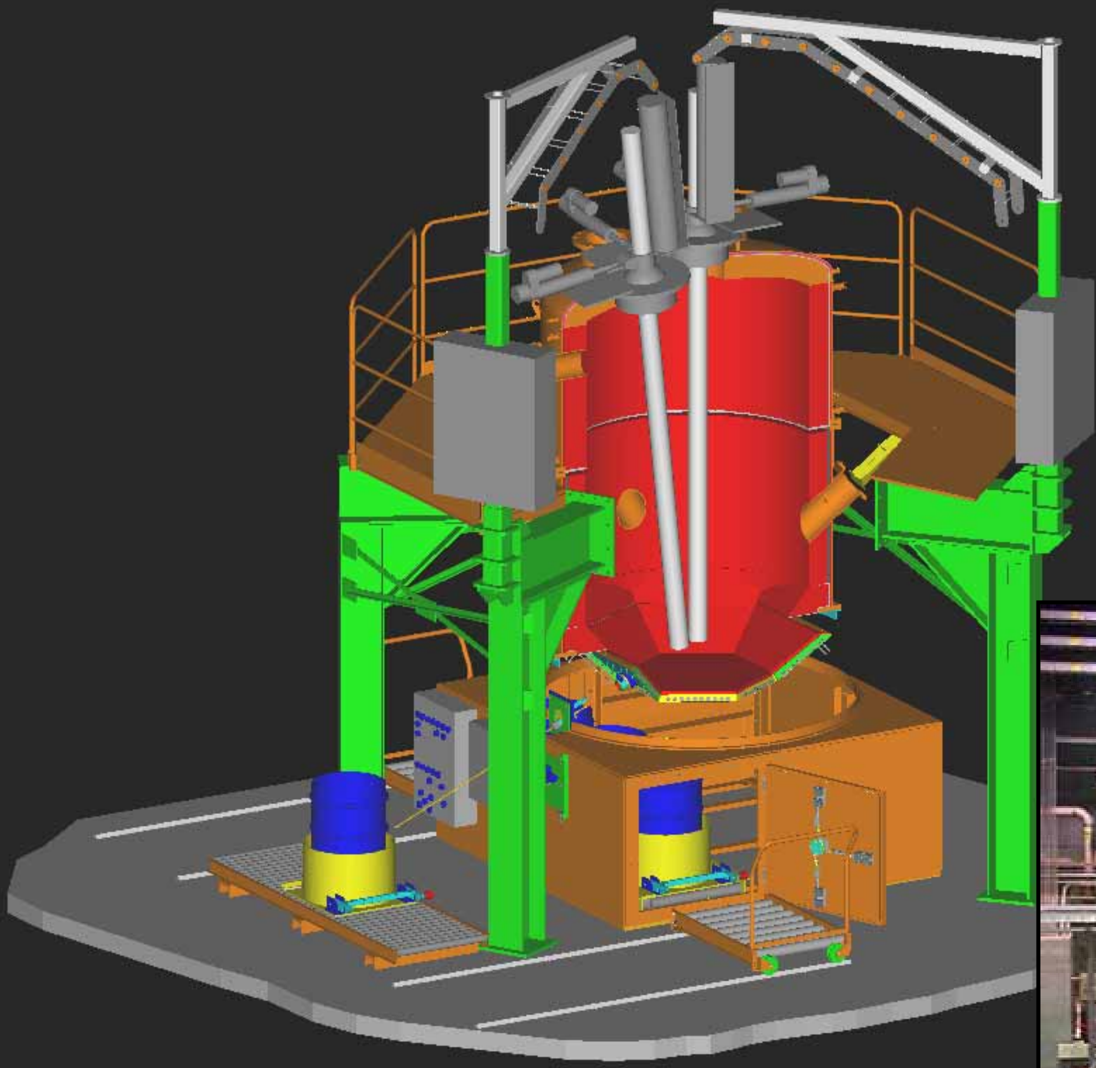
Other Items:

- Riot Control
- Incendiary
- Phosphorous
- Propellant & Cartridge Increments
- Cartridge an Propellant Actuated Devices
- By-Products of R^3 (e.g. Mortar Ignition Cartridges
- Fuzes
- Small High Explosive Components & Items

PODS PROCESS CONFIGURATION



PLASMA ARC FURNACE



SLAG: PLASMA FURNACE OUTPUT

PODS FACILITY

HAWTHORNE ARMY DEPOT, HAWTHORNE, NV

Ordnance Up

Soil In

Ordnance In

ORDNANCE CRANE & FEEDER

Ordnance/Soil
Conveyors & PODS
Furnace

SOIL FEEDER & CONTROL ROOM

Slag Collection Chamber & Slag Crane

Pollution Abatement Equipment

Pollution Abatement Equipment & Cooling Towers

Water Treatment System

Evaporation Pond

Water Storage Pond

TESTING OVERVIEW

- Operational Verification Testing (OVT) Status: 7/7 Weeks Completed
- Preliminary Testing (PT) aka "Miniburns": Status: 5/11 Weeks Completed
  - Establishes reliable operation in preparation for the Comprehensive Performance Test (CPT)
  - Four phases:
    - Feed Rate Determination
    - Feed Rate Verification
    - CEMS/COMS
    - CPT/Risk Burn Pre-Run
- Performance Verification Testing (PVT):
  - 1 week-long, 24 hour per day test with ordnance
  - Verifies duration performance
- CPT / Risk Burn Test:
  - 3 replicate 1-day tests
  - Establishes environmental compliance under MACT & RCRA

TEST ITEMS

DODIC	NOMENCLATURE	TYPE	Weight (lbs.)
D450	Canister, 155mm HC M2 Smoke	Pyro. (Smoke)	21,247
G960	Grenade, Hand Riot, CN,M7	Riot Control	660
G930	Grenade, Hand Smoke HC AN-M8	Pyro. (Smoke)	70.4
G932	Grenade, Hand Smoke Red M48	Pyro. (Smoke)	57
L592	TOW Missile Blast Simulator Assembly	Pyro. (Simulator)	42.85 lbs. ~710 (items)
D445	Canister, 155mm HC M1 Smoke	Pyro. (Smoke)	
L366	Simulator, Projectile, Airburst, M74A1/M74	Pyro. (Simulator)	
L602	Simulator, Flash, Artillery, M21	Pyro. (Simulator)	
F989	Fuze, Bomb, Tail, M905	HE Fuze	
	>> Additional Items TBD <<		

PROJECT STATUS

- Testing Accomplishments:
  - Maximum Feed Rate of 1500 lbs/hr for the D450.
  - Sustained Feed Rate of 984 lbs/hr for the D450.
  - Torch Operation: 374 hrs at HWAD (590 hrs Total)
  - Sampling conducted when processing the D450 Smoke Canisters, Naphthalene (POHC), and spiked metals.
    - System DRE: >99.9999%.
    - Emissions were below MACT Limits, except for Hg.
  - Demonstrated the ability to process several other items.
- Resolved several technical issues.
- Currently conducting an upgrade to the Slag Chamber and Slag Tapping operation.
- The Comprehensive Performance Test Plan (CPTP) has been completed and has received approval from the Nevada Division of Environmental Protection.

PROGRAM SCHEDULE

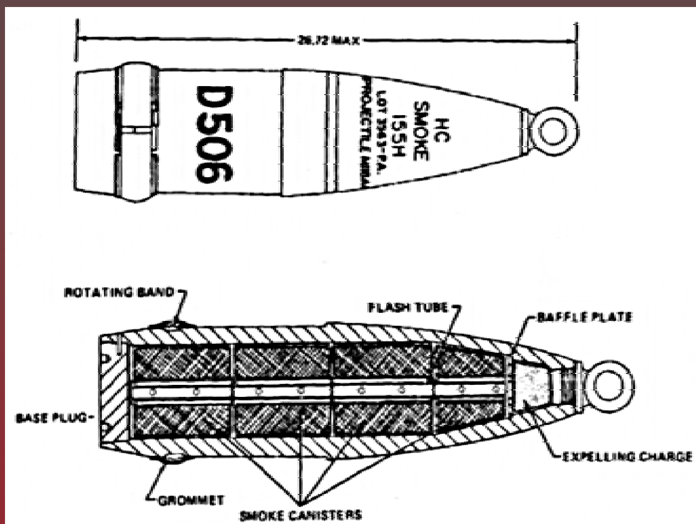
	FY 2006											FY 2007							
TASK	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Preliminary Testing & Performance Verification Testing																			
Comprehensive Performance Test/Risk Burn Test																			
Data Analysis, Report, & Obtain NDEP/RIX Approval																			
Initial Workloading																			

PODS PLANNED WORKLOAD

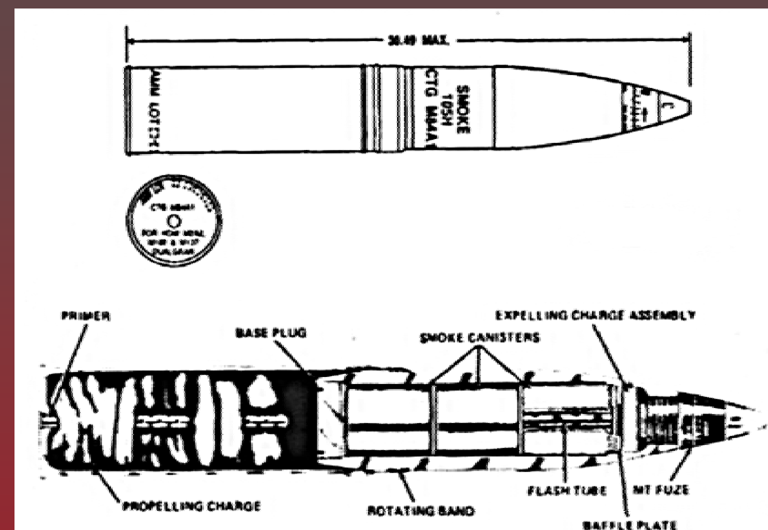
One Million Canisters

1.2 Years at 24/5 Shift

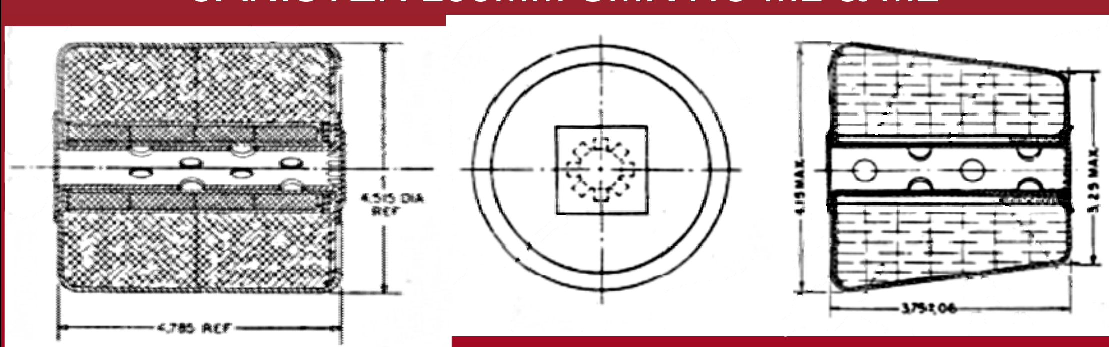
PROJ., 155MM, SMOKE, HC, M116A1



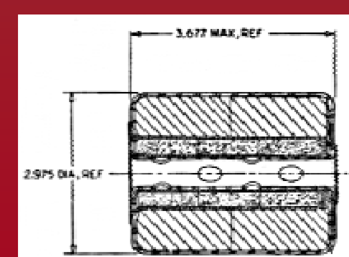
CARTRIDGE, 105MM, SMOKE, HC, M84 SERIES



CANISTER 155MM SMK HC M1 & M2



CANISTER 105MM SMK HC M1

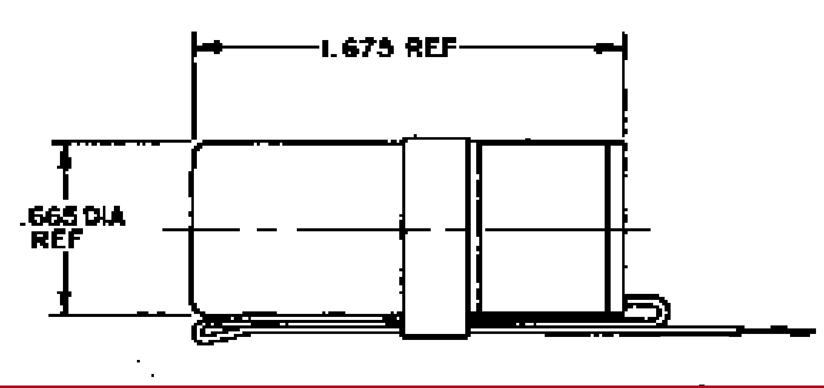


WORKLOAD ITEMS

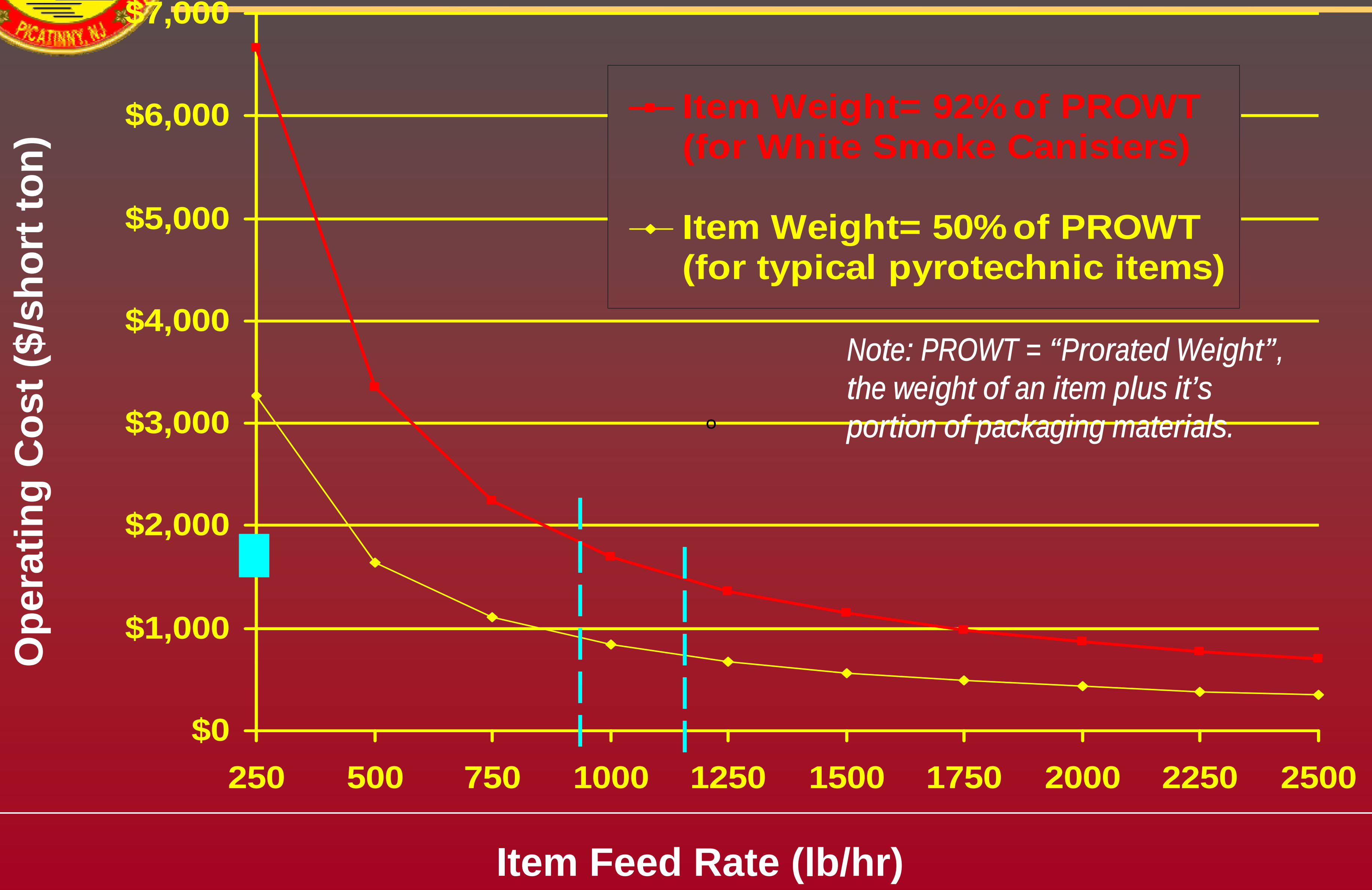
ADDITIONAL POTENTIAL WORKLOAD

TOW Missile Blast Simulator Assembly

- Approximately 54,000 currently located at HWAD
- AMCOM priority to demil
- Will demonstrate synergy between conventional ammo and tactical missile demil



PODS OPERATING COST ESTIMATE



SUMMARY

- The Plasma Ordnance Demilitarization System at Hawthorne Army Depot Will Provide the US Army with a State-of-the-Art Demilitarization Capability for Completely Assembled, Small Smoke and Pyrotechnic Ordnance, as well as a Variety of Other Ordnance.
- PODS:
  - Is safe
  - Is an environmentally compliant alternative to OB/OD
  - Captures hazardous constituents of the ordnance in a low-leachable, non-hazardous final waste form
  - Is cost effective

Requalification of Demilitarized HMX for DOD/DOE Applications

A Joint Program Between:

NAVSEA
INDIAN HEAD
Surface Warfare Center Division

Los Alamos

TPL, INC.

NAVSEA
CRANE
Surface Warfare Center Division

Authors

Dan Burch, NSWC/Crane

Sheldon Larson, LANL

Kerry Clark, NSWC/IHD

Tiffany McGregor, NSWC/IHD

Randal Johnson, TPL, Inc.

Why Requalify?

- Environmentally responsible
- DOD (Gansler memo of Dec. 00) endorses/promotes military reuse

- Available HMX resource
- Lower cost
- HMX is HMX

Based Around LX-14 Process

- TPL patented nitric acid degradation
- 150 - 200 lb / batch
- No waste generated

- By-products recycled into blasting agent

HMX Recovery

TPL Contribution

- ❑ **Prepared & provided classified HMX from LX-14.**
- ❑ **Processes established for demil of PBX-9501 and PBXN-110. Samples provided for analyses.**
- ❑ **Tested & established scale-up of classification.**
- ❑ **Provided larger samples of Class 1 and Class 5 LX-14 HMX for formulation testing to IH, LANL, and ATK.**
- ❑ **Scale up recovery processes for other explosives.**

Ft. Wingate Construction

Future Plans

- Continue construction of HMX facility
- Specify, purchase, and install equipment
- Prove-out new HMX recovery process facility (600 lbs/batch)
- Supply HMX for testing purposes

INDIAN HEAD

QUALIFICATION TESTING FOR PBXN-113 CONTAINING RECLAIMED HMX

Tiffany C. McGregor
Kerry A. Clark
Matthew Beyard
Karrie Sandagger

2006 Global Demilitarization Symposium

Naval Surface Warfare Center, Indian Head Division
Indian Head, MD 20640

Outline

- Specification Testing
- Formulation & Processing
- Qualification Testing
- Specification Aging Study
- Extremely Insensitive Detonating Substance (EIDS) Testing
- Summary
- Future Plans

Specification Testing

MIL-DTL-45444C, HMX Grade B, Requirement	MIL-DTL-45444C, HMX Grade B, Test Method
3.2 Purity HMX β-polymorph, 98% by weight, min HMX α-polymorph, 0.01% by weight, max RDX Content, 2.0% by weight, max	4.7.1 X-ray Diffraction HPLC for HMX Purity & RDX Content
3.2 Melting Point, ºC, 277 min	4.7.2 Fisher-Johns or Equivalent
3.2 Number of Insoluble Particles On a USS #40 Sieve-0 max On a USS #60 Sieve-5 max	4.7.3 Per Specification
3.2 Total Acetone Insolubles, 0.05% max	4.7.4 Per Specification
3.2 Inorganic Insolubles, 0.05% max	4.7.5 Per Specification
3.2 Acidity, 0.02% by weight, max	4.7.6 Per Specification
3.2 Impact Sensitivity 17 cm min ERL, Type 12 Tools, 2.5 kg weight	4.7.7.3 Per Specification
3.2/3.2.1 Granulation by Class	4.7.8 Per Specification
3.2/3.4 Workmanship	4.7.9 Per Specification

Specification Testing

HMX Spec. Testing	Tests Performed	Units	PBXN-110 Class 1	PBXN-110 Class 3	LX-14 Class 1	LX-14 Class 5	PBX 9501 Class 1	PBX 9501 Class 2	Mil-Spec
Acetone Insoluble	Average	wt %	0.03	0.04	0.013	0.006	0.024	0.023	0.05
Insoluble Particles	Retained on USSS #40 Average	number	0	2	0	0	1	1	0
	Retained on USSS #60 Average	number	0	2	0	0			5
Inorganic Insoluble	Average	wt %	0	0.02	0	0	0	0.007	0.03
Sieve Analysis	Thru USSS #12 Average	wt %	NA	100	NA	NA			NA
	Thru USSS #50 Average	wt %	96	46	95	NA	95	100	90 +/- 6
	Thru USSS #100 Average	wt %	57	17	59	NA			50 +/- 10
	Thru USSS #120 Average	wt %	NA	NA	NA	NA			NA
	Thru USSS #200 Average	wt %	21	7	21	NA			20 +/- 6
	Thru USSS #325 Average	wt %	7	NA	7	95			8 +/- 5
Acidity	Average	wt %	0	0	0.014	0.009	0.014	0.011	0.02
Microtrac	FRA10 Average	microns	58.6	49.4	60	15.6			NA
	FRA50 Average	microns	149.9	268.8	134.9	32	102	39	NA
	FRA90 Average	microns	343.3	552.7	276.9	53.6			NA
	FRAMV Average	microns	179.6	285.7	156.9	33.7			NA
Melting Point	Average	degrees C	269	271	278	279	269	266	277
Purity %RDX in HMX	Average	wt %	0	0	0.7	0.5	0	0	2
DSC Onset Degree C	Average	degrees C	276.73	275.55	282.38	282	282.82	284.27	
DSC Peak Degree C	Average	degrees C	277.7	276.83	284.07	283.66	284.2	285.66	

Other tests: Crystal morphology by SEM, TGA, GC/MS, VTS

Specification Testing

Tests Performed	Sensitivity Testing				
Sample	NOS Impact 50% hgt. (mm)	ERL Impact 50% hgt. (cm)	ABL Friction 20 TIL (psig)	BAM Friction 10 TIL (newtons)	ABL ESD 20 TIL (joules)
PBXN-110 Class 1	169 M	18 M	180 M	84 M	0.326 M
PBXN-110 Class 3	209 M	19 M	100 M	72 M	0.165 M
LX-14 Class 1	178 M	24 M	<30 H	96 M	0.095 M
LX-14 Class 5	132 M	24 M	<30 H	108 M	0.037 M
RDX 'A' Standard	277 M	17 M	235 M	120 M	0.326 M
Medium Sensitivity = M					

Formulation & Processing

- Composition
  - 45% Class 5 HMX
  - 20% Binder Material
  - 35% Aluminum

- HMX was recovered from LX-14
  - Indian Head ground the Class 1 using a fluid energy mill into Class 5
  - Two 5-gallon batches were formulated and cast into test charges
  - No processing changes were needed, process was identical for PBXN-113 made with virgin HMX
  - X-Rays of the charges revealed no anomalies

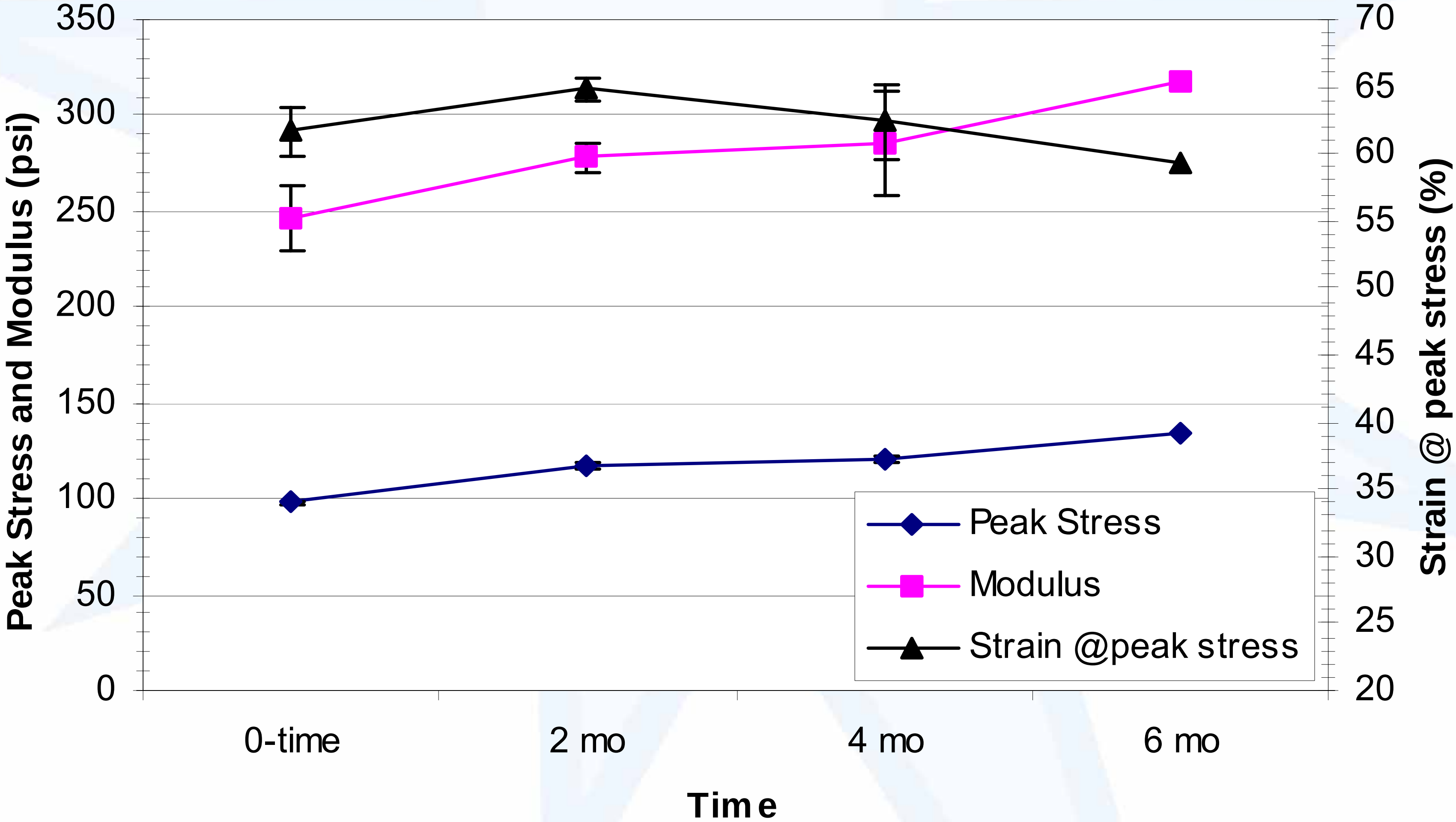
Qualification Testing

- In accordance with MIL-STD-1751A
- Slight increase in sensitivity due to processing of reclaimed HMX

Test	PBXN-113 with Virgin HMX	PBXN-113 with Reclaimed HMX	Units
Impact Sensitivity	98	83	cm
Friction Sensitivity	<980	560	psig
Electrostatic Discharge	.326	.853	Joules
Vacuum Thermal Stability	.09	.146	ml/g/48hrs
Gap Test (50% Point)	112	105	Cards
Cap Test	No detonation	No detonation	
Thermal Stability	No Reaction or changes	No reaction or Changes	
Ignition and Unconfined Burning	Burned	Burned	
Detonation Velocity	6.97	6.98	mm/μs
Critical Diameter	< 0.250	< 0.375	inches
Slow Cook Off	Burned	Burned	

Specification Aging Study

- Samples aged at 70°C for 6 months
- No significant changes in Mechanical Properties



EIDS Testing

- PBXN-113 with virgin HMX was qualified as an Extremely Insensitive Detonating Substance (EIDS), NAVSEAINST 8020.8B UN Test Series 7
- PBXN-113 formulated with R-HMX was also put through these tests

EIDS Friability - Passed

- Bare samples were projected against a steel plate
  - 9 grams, 18 mm in diameter
- Three low pressure closed bombs were performed on samples
  - Maximum measured 0.05 MPa/ms

EIDS Cap - Passed

- Three tests
  - 5lb sample placed on lead cylinder on witness plate.
  - RP-502 detonator perpendicular to sample and initiated
- No detonation

EIDS Slow Cook-off - Passed

- Three tests were performed
  - Oven controlled thermal environment, 40°C to 365°C @ 3.3°C/hr
  - Reaction temperatures at 187°C, 193°C, and 191°C. Pressure ruptures and reactions were burning

EIDS Testing Continued

EIDS External Fire - Passed

- Three sets of five samples, banded together
  - 1.78” X 7.875” steel pipes
- No fragments found beyond 15 meters weighing more then 1 gram
  - No overpressure for any of the 15 reactions
  - No significant heat flux output
  - No damage to witness screens

EIDS Gap - Passed

- Three gap test units were tested
  - No detonations or explosions
  - Recovery of most of the unreacted explosives
  - No damage to witness plates

Summary

- Comparison of the results from the characterization and specification testing of recycled HMX to that of virgin HMX manufactured by Holsten show few qualitative differences

- The replacement of R-HMX for virgin HMX did not cause any significant changes in the explosive's sensitivity, performance, or aging characteristics in PBXN-113

Future Plans

- Expeditionary Fire Support System (EFSS) 120 mm rifled mortar has been identified as a potential customer
  - Holds 9 lbs of PBXW-128 containing 77% Class 5 HMX
  - Currently going through Hazard Assessment / Classification testing required to meet MIL-STD-2105C, Hazard Assessment Testing for Non-Nuclear Munitions and Final Type Qualification in accordance with NAVSEAINST 8020.8C using virgin HMX
- If R-HMX can be used in the EFSS rifled mortar, the Marine Corps Systems Command would be able to purchase more of the EFSS units
- Process for Qualifying
  - Verify the quality of the R-HMX through specification testing
  - Formulate the R-HMX into PBXW-128
  - Perform qualification testing on the formulation
  - Mirror several of the EFSS IM and environmental tests with the PBXW-128 containing recycled HMX

Acknowledgements

- Lori Nock, Dan Burch and Sara Poehlein for their suggestions, technical guidance and program management
- The Chemical Analysis Laboratory and the Energetic Tests Development Division of the Energetics Evaluation Department of NSWC Indian Head Division
- Defense Ammunition Center (DAC) and PM DEMIL for funding this effort

Operational Experience in Photocatalysis:

Treatment of Pink Water, Nitroglycerine & CWA

Brian Butters, P.Eng., MBA
Tony Powell, P.Eng.

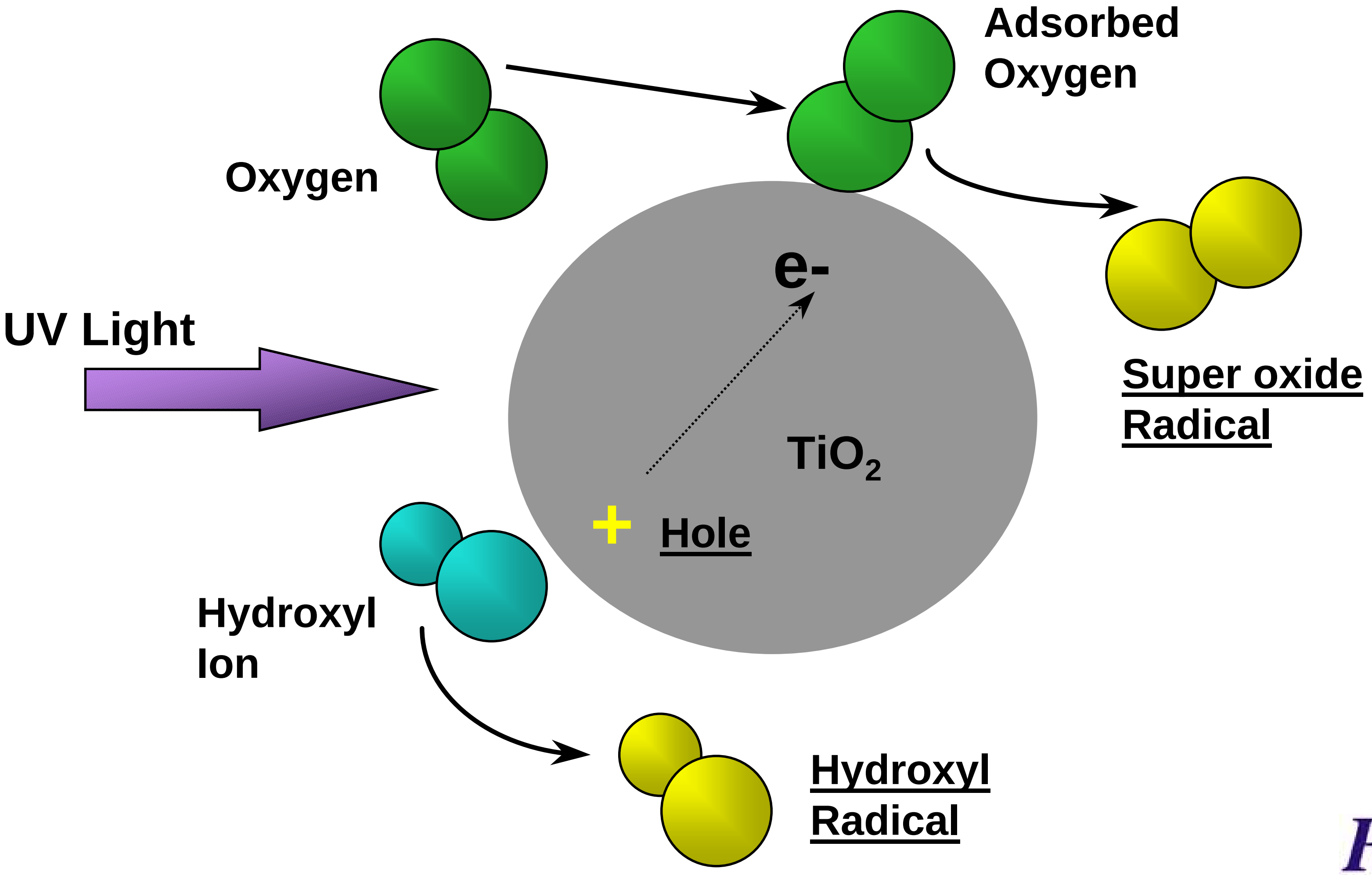
Photocatalysis Background

- Livelihood Since 1990
- Purifics Core Business Since 1993
- Slurry; Commercially Viable & Proven
  - Photo-Cat 30+ installations
- Fixed; NOT Commercially Viable
- Barriers to Application
  - Underdeveloped Sci/Eng
  - Mis-information

Presentation Scope

- **Photocatalysis: What is it?**
- Modes of Treatment
- Pink Water
- Nitroglycerine Air Emissions
- Chemical Warfare Agents
- Summary

Photochemistry



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Oxidative Power

Oxidizing Species	Relative Power
Photo-Generated Hole on TiO_2 *	**2.35**
Fluorine	2.23
Hydroxyl Radical *	**2.05**
Atomic Oxygen	1.78
Ozone	1.52
Hydrogen Peroxide	1.31
Permanganate	1.24
Hypochlorous Acid	1.10
Chlorine	1.00

***Oxidizing Species Generated by Photo-Cat**

Purifics.com

Treatability

Groundwater, Process Water, Air

…contaminated by …

MTBE/BTEX, PAHs, PCBs, TCE/PCE, NAPL, Dioxins/Furans, Chlorinated Organics, Hydrocarbons, 1,4-Dioxane

---

…and …

Acetone, Aniline, Anthracene, Aroclors, Benzene, Benzothiazole, Bis (2-chloroethyl) ether, Bis (2-ethylhexyl phthalate) ether, 2-Butanone, Carboxin,Chloroaniline, Chlorobenzene, Chloroethane, Chloroform, Chlorophenol, Cresols, Cyanides, Di-N-butyl phthalate, Diacetaldehyde, Dichlorobenzene, 1,1-Dichloroethane, 1,2-Dichloroethane, Dichloroethlyene, 2,4-Dimethylphenol, 2,6-Dinitrotoluene, 2,4-Dinitrotoluene, 1,3-Dinitrobenzene, Diphenylhydrazine, Dioxane, DMN, Energetics, Ethanol,Ethylbenzene, Formaldehyde, Freon 11, Freon 113, Glycols, Glycerol Trinitrate, HMX, Hydrolysates, IPA,MEK, Mercaptan, 2-Mercaptobenzothiazole, Methanol, 1-Methylnaphthalene, 1-Methly-2-Pyrrolidone, Methylene Chloride, methylphenol, MIBK, Monoacetaldehyde, Monethanolamine (MEA), Naphthalene, NDMA, Nitroaniline, Nitrobenzene,Nitroglycerine, PCBs, Phenols, RDX, Styrene, Tetrahydrofuran (THF), Toluene, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 2,4,6-Trinitrotoluene (TNT), 1,3,5-Trinitrobenzene (TNB), Trichlorofluoromethane, Vinyl Chloride and Xylenes among others.

Photo-Cat Advantages

- Lowest Life Cycle Cost
- No Waste Generated
- Reduced Treatment Train & Footprint
- No Quartz or Catalyst Fouling
- Unaffected by Turbidity, Dissolved Solids/Metals
- Community & Regulatory Acceptance
- Modular Components
- Metals Polish; Hg, Tc99, Fe, Chelations etc

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Photo-Cat

PHOTO–CAT

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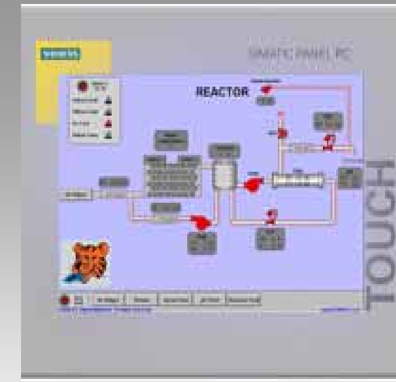
Control Cabinet



Ballast Cabinet

Ballast Cabinet

CRU Flow Module = 500L/min

Reactor Module

Pallet

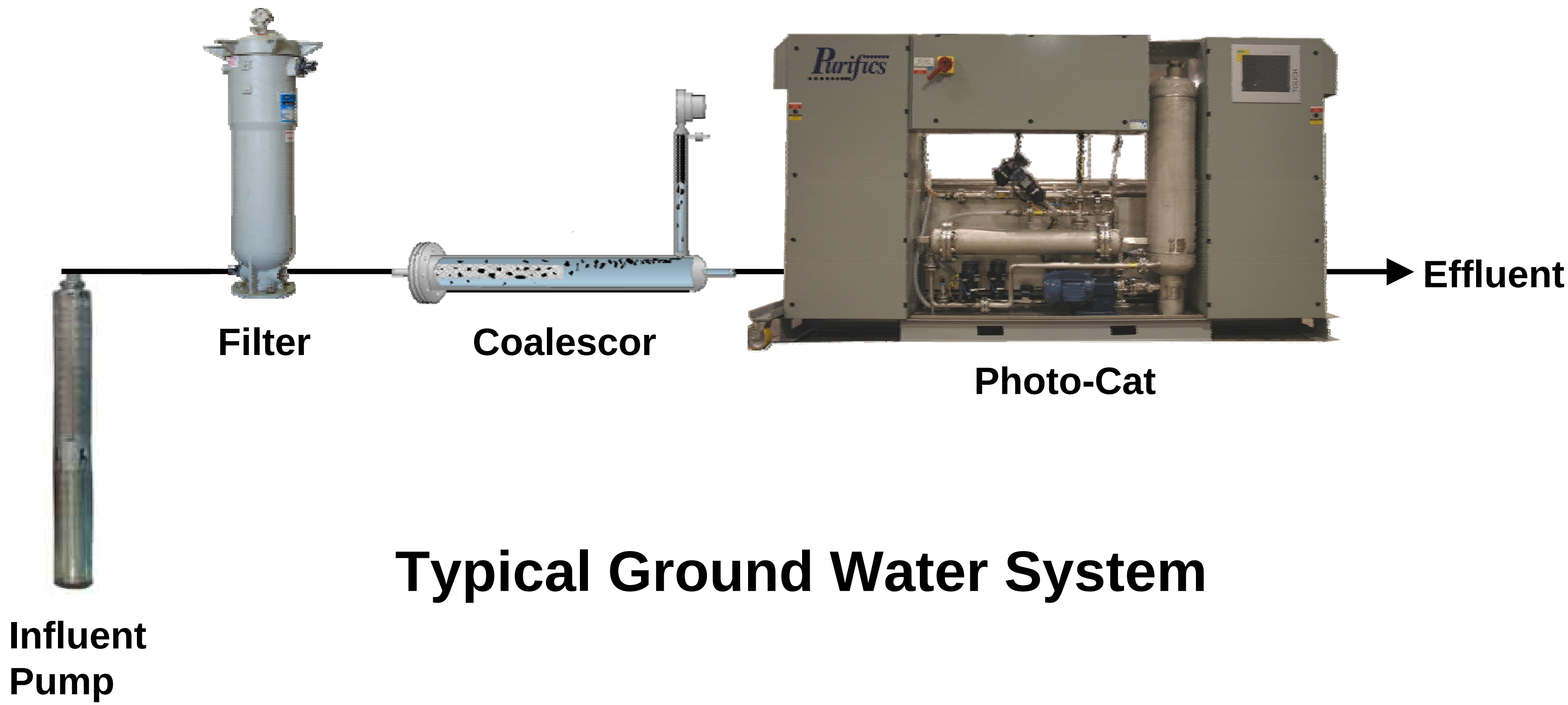
Photo-Cat: Models

Models	Applications
RI	**Remediation** **Industrial**
NMP	**Nuclear** **Military** **Pharmaceutical**
UV+	**Disinfection & Photolysis**
MR	**Metals Removal**
L	**Laboratory**

Presentation Scope

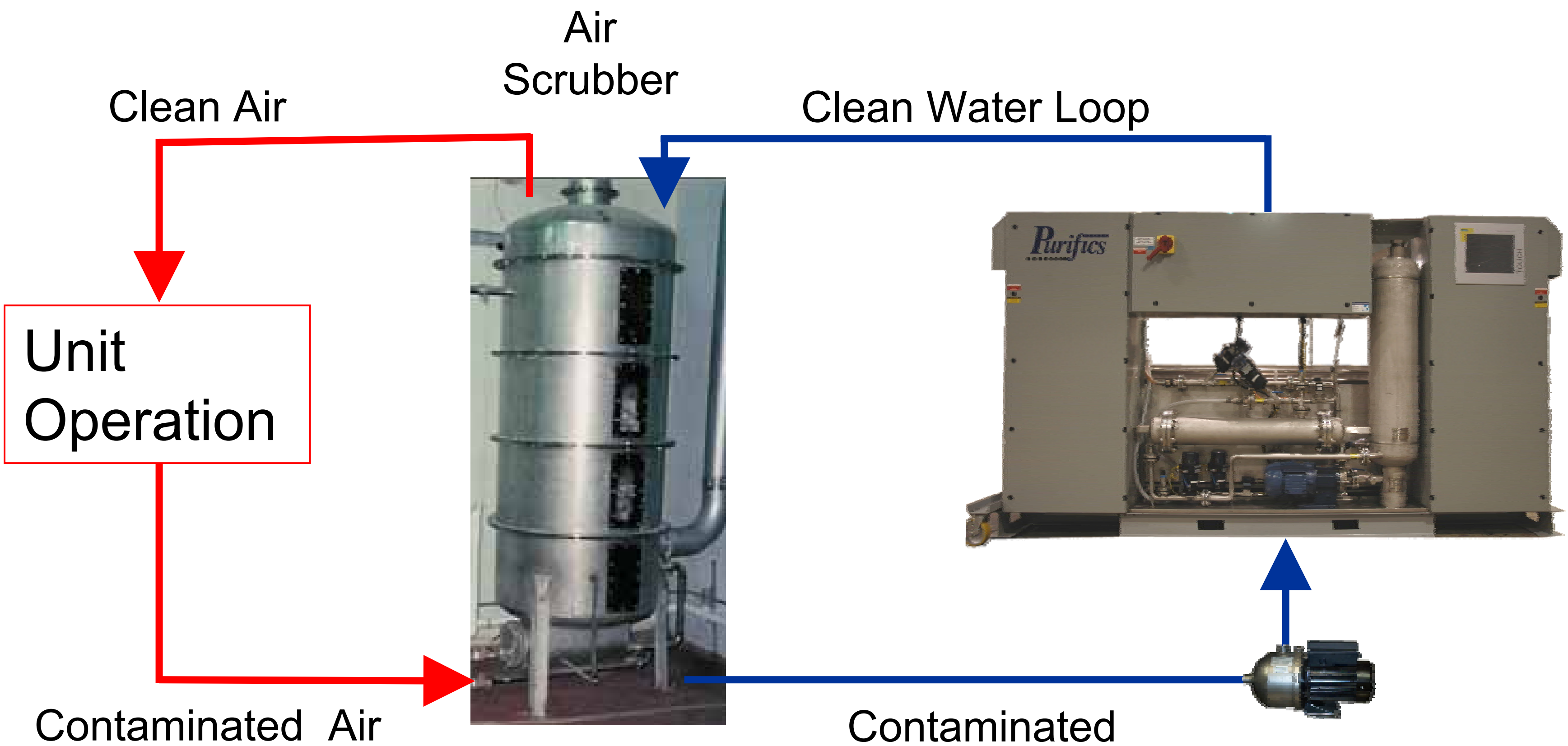
- Photocatalysis: What is it?
- **Modes of Treatment**
- Pink Water
- Nitroglycerine Air Emissions
- Chemical Warfare Agents
- Summary

Treatment Modes



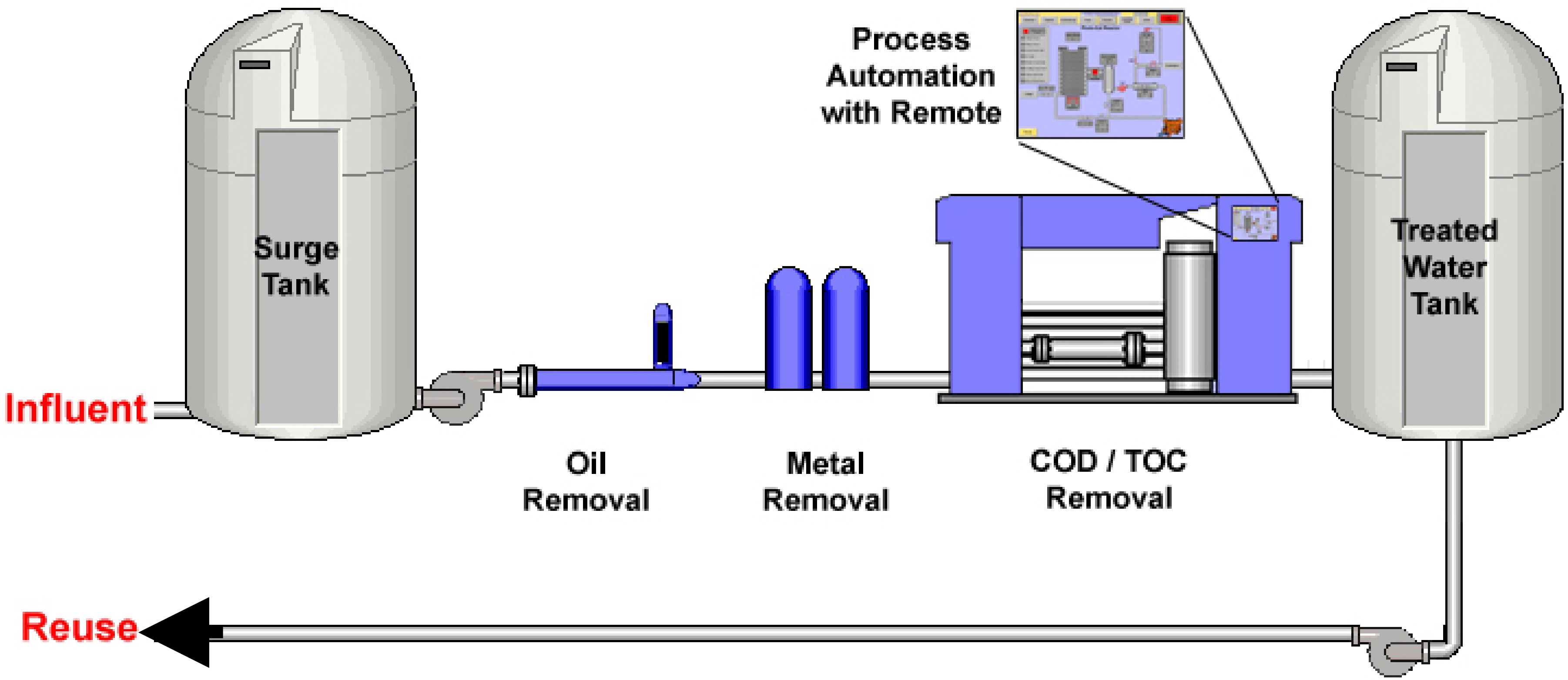
Typical Ground Water System

Treatment Modes



Typical Air System

Treatment Modes



Typical Process Water System

Presentation Scope

- Photocatalysis: What Is It?
- Modes of Treatment
- **Pink Water**
- Nitroglycerine Air Emissions
- Chemical Warfare Agents
- Summary

Pink Water Remediation

Ground Water

Pink Water Treatment Data

	Influent	Effluent	Energy
2,4,6-TNT	703 ppb	<1 ppb	10.2 kWh/m3
1,3,5-TNB	570 ppb	<1 ppb	

2006 Data 5 kWh / m3

Oxidative/Reductive Pathways

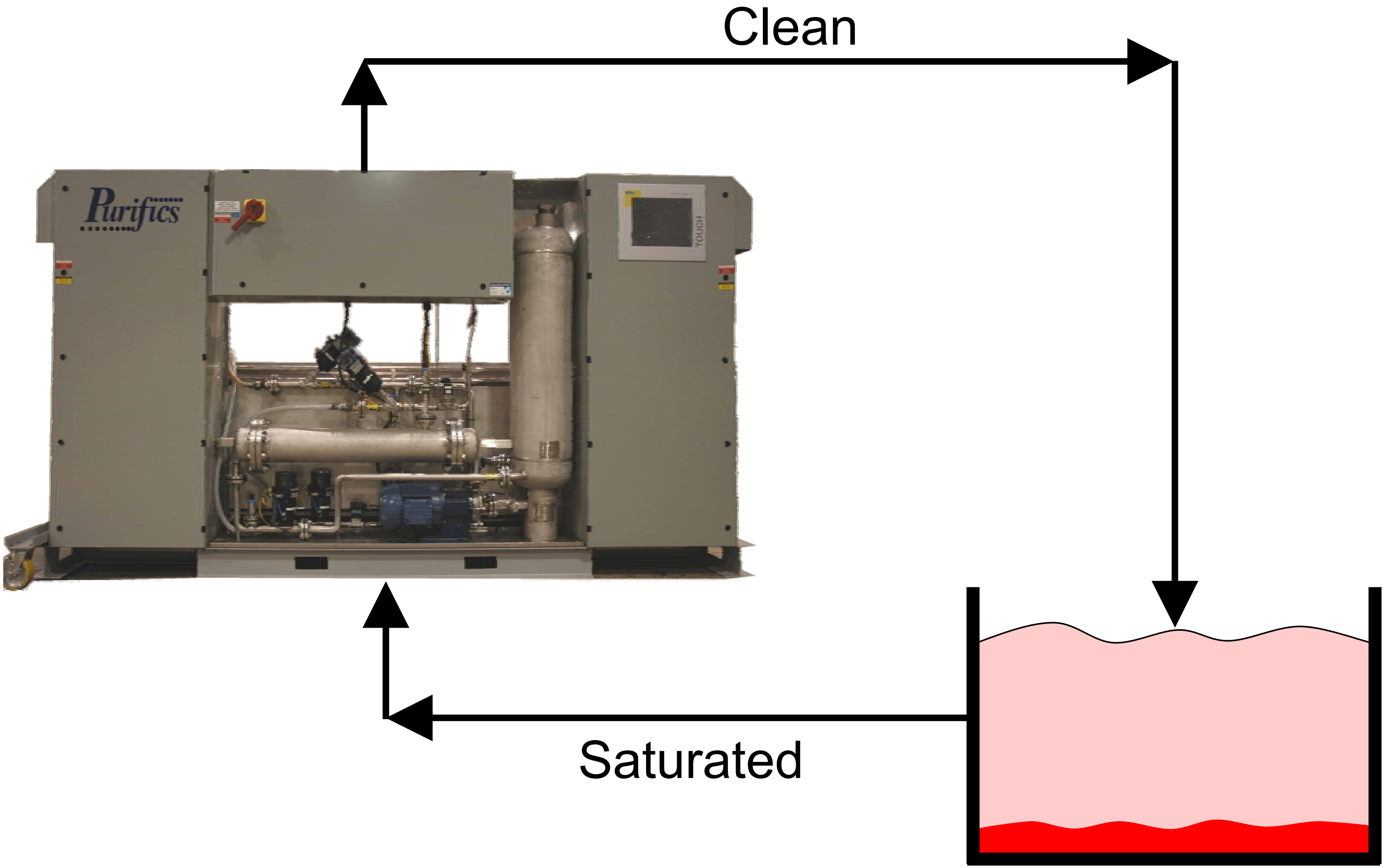
TNT $\xrightarrow{\text{Oxidation}}$ **TNB** $\xrightarrow{\text{Reduction}}$ **Detoxified**

Refractive By-Product

Pink Water Remediation

- Most Effective Treatment Process
- Treated without Peroxide or Ozone
- Detail in Technical Eval. Report
- Avoid Plastic Components

Red Water Treatment



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Presentation Scope

- Photocatalysis: What Is It?
- Modes of Treatment
- Pink Water
- **Nitroglycerine Air Emissions**
- Chemical Warfare Agents
- Summary

Purifics.com


EMPTY
EMPTY

Shell Extrusion Air Emissions

Purifics.com

Presentation Scope

- Photocatalysis: What Is It?
- Modes of Treatment
- Pink Water
- Nitroglycerine Air Emissions
- **Chemical Warfare Agents**
- Summary

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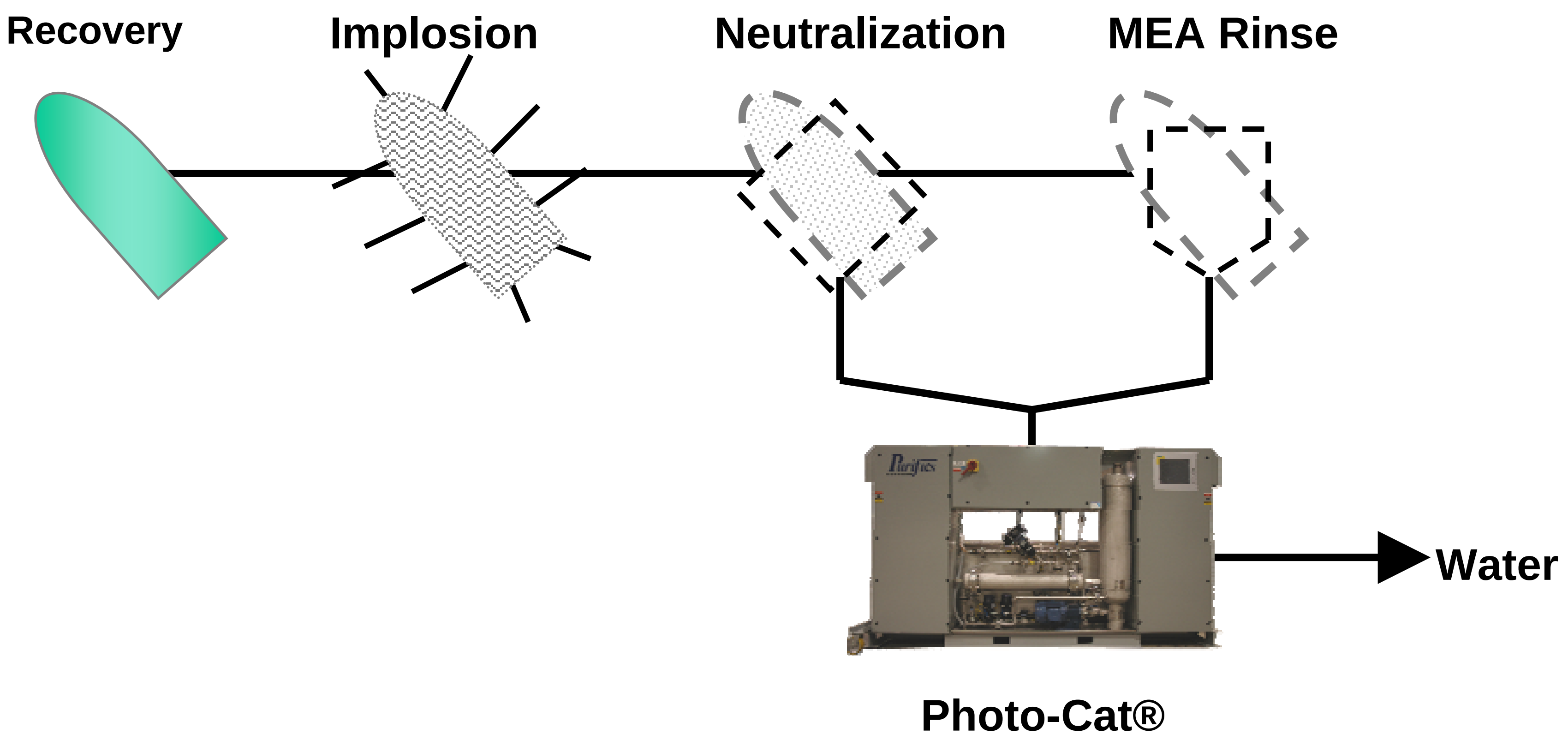
NSP CWMs Process Flow



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Aberdeen

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CWA MEA Data

- Actual

Influent	Effluent	Energy
1,610 ppm TOC	<25 ppm	330 kWh/m^3

- Surrogate

Influent	Effluent	Energy
2% MEA, 20,000 ppm	ND	1000 kWh/m^3
7,800 ppm TOC	<25 ppm	

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Mustard Gas /Aberdeen

- **Big "O" Field**

Contaminant	Influent	Effluent
1,4-oxathiane	113 ppb	<0.3 ppb
1,4-dithiane	700 ppb	<0.3 ppb
thiodiglycol	648 ppb	<0.3 ppb

2.6kWh/m3

Presentation Scope

- Photocatalysis: What Is It?
- Modes of Treatment
- Pink Water
- Nitroglycerine Air Emissions
- Chemical Warfare Agents
- **Summary**

Summary

- Technology is Broadly Applied
- It is Proven, Mature, Efficient
- High Reliability & Durability
- Mass Transfer Solved
- 18,000 – 24,000 Service Interval
- Further Application
  - Hydrolysates
  - Perchlorate
- Simple
- Safe

Purifics.com

Contact Information

Corporate Headquarters

- Purifics ES Inc.
  340 Sovereign Rd.
  London, Ontario N6M 1A8
  Canada
- 519.473.5788 (Voice)
  519.473.0934 (Fax)
  info@Purifics.com
  www.Purifics.com

Technical & Business Development Inquiries

- info@Purifics.com

Presentation Available for One Week Online

- http://www.purifics.com/login/index.html
- Select “Presentations”

Username: **user1**

Password: **pieprlup**

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Ground Water

- **Savannah Army Depot, Aberdeen, Michoud Assembly Facility**
  - **TNT → TNB → DNB→…**
  - **Mustard Gas Break Down Products**
  - **Chlorinated VOCs**
- **Unaffected by Salts**
- **No Accumulation of Waste**

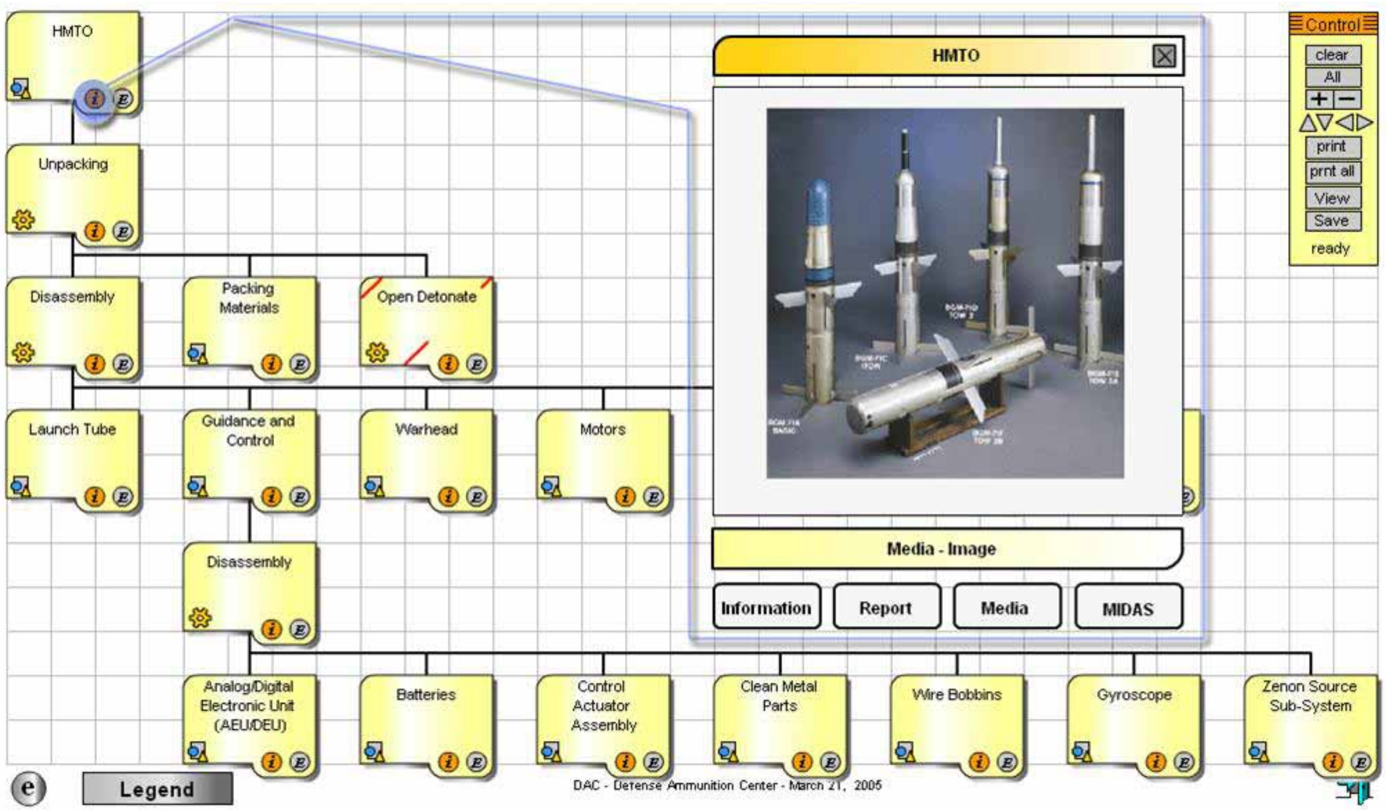
Air Emissions

- **Indian Head-Naval Surface Warfare Center, Korean Military**
  - **Nitroglycerin Based Propellant Annealing Off-Gas**
  - **Extrusion Off-Gas Treatment**
- **Unaffected by Nitrate Ion**
- **Closed Loop - Fluid Reuse**

Pollution Free Processing Installation Case History

- **Anneal NG-based Propellants**
- **Off-gas Treatment; 10,000cfm; 50kg/day**
- **Closed Loop Working Fluids**
- **Acid By-Product Reused**
- **No NG Discharge to Environment**
- **Prevent Health & Explosion Hazards**

MIDAS Technology Trees



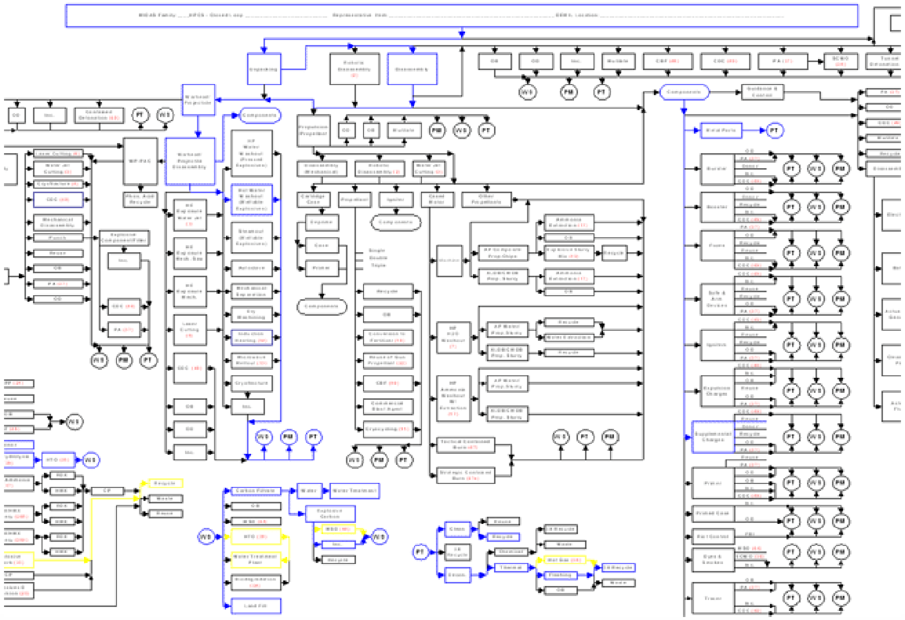
JMC – On The Line

Web-Based Knowledge Management Tool

- Information visualization via interactive, graphical user interface
- Displays demilitarization process alternatives for each MIDAS family
- Automated tool to assess <u>all</u> demilitarization technology alternatives
- Will Link to MIDAS database for additional munitions information
- Will Link to Ammunition Peculiar Equipment (APE) website
- Customizable to suit user needs and future growth
- Developed by DAC in collaboration with University of Oklahoma through CELDi program

Historical Perspective

- Initial trees developed in FY2000 to support Congressionally mandated Tactical Missile Demilitarization Roundtable Study
- Used to support FY2001 Closed Disposal Study, FY2004 Bulk Energetic Material Economic Analysis Study & MLRS Demil Study Group

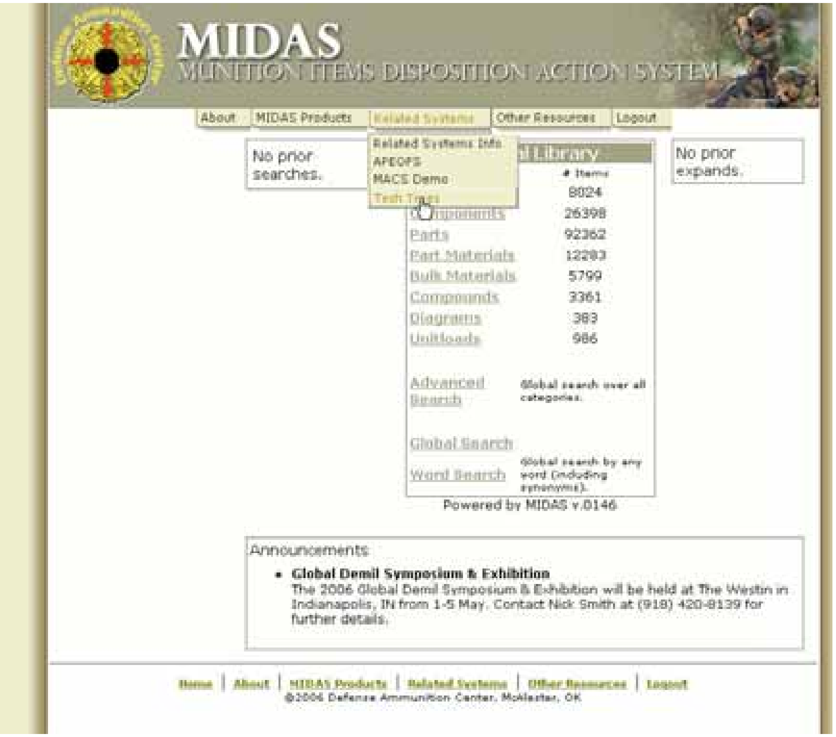


Current Status

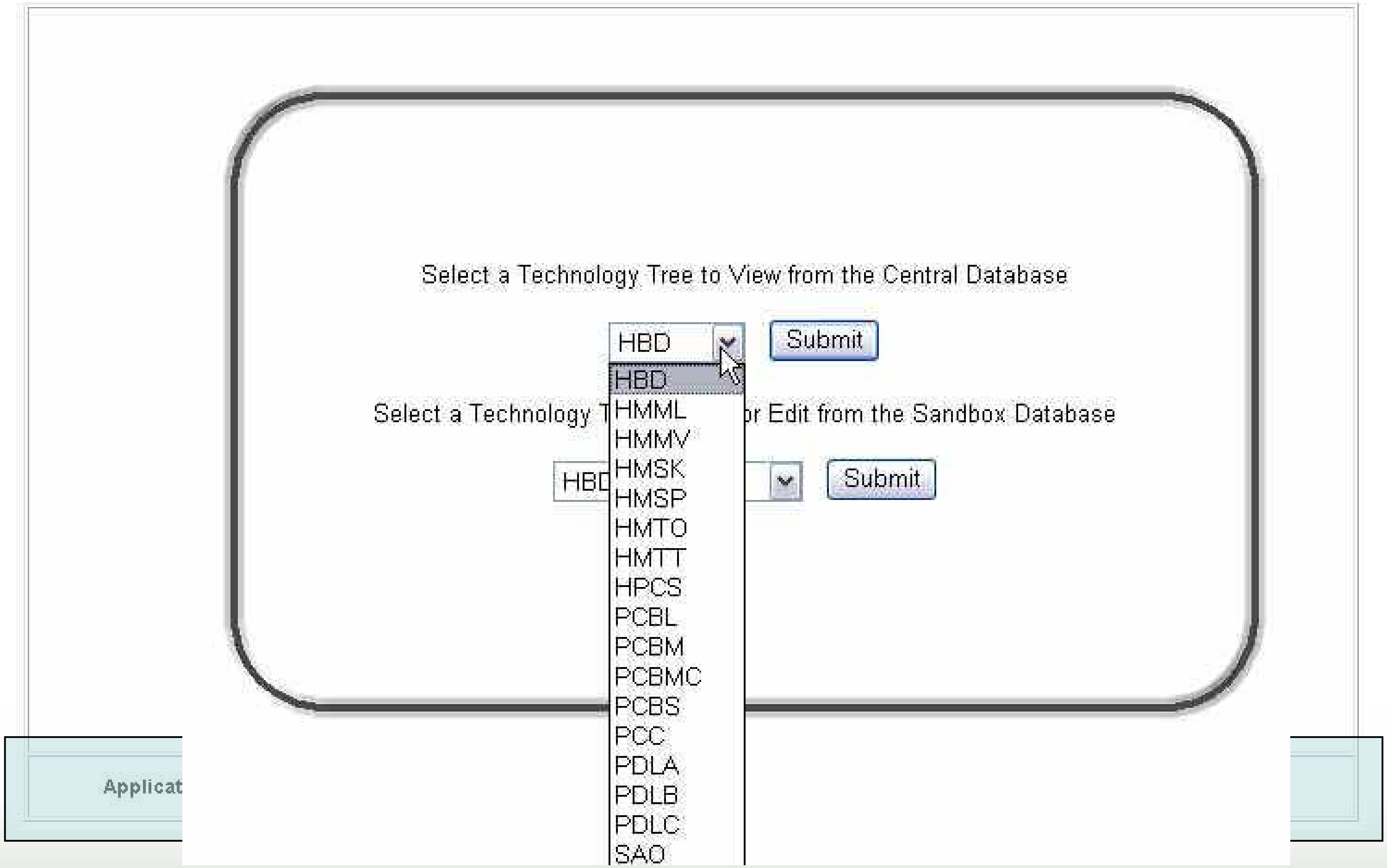
- Application is online and available for use
- Technology Trees drafted for each MIDAS family
  - Finalization pending review and modification
- Completed Technology Trees
  - 25 Missile Systems
  - 21 Conventional Munitions Families
- Finalizing other families to support R3 demilitarization programs
  - Team effort with DAC – LEMC – AMCOM
  - Supports the development of R&D for ammunition demilitarization
- Developing interactive links to access other data caches
  - Enhance user capabilities for ‘one-stop-shop’ DEMIL data access

Access

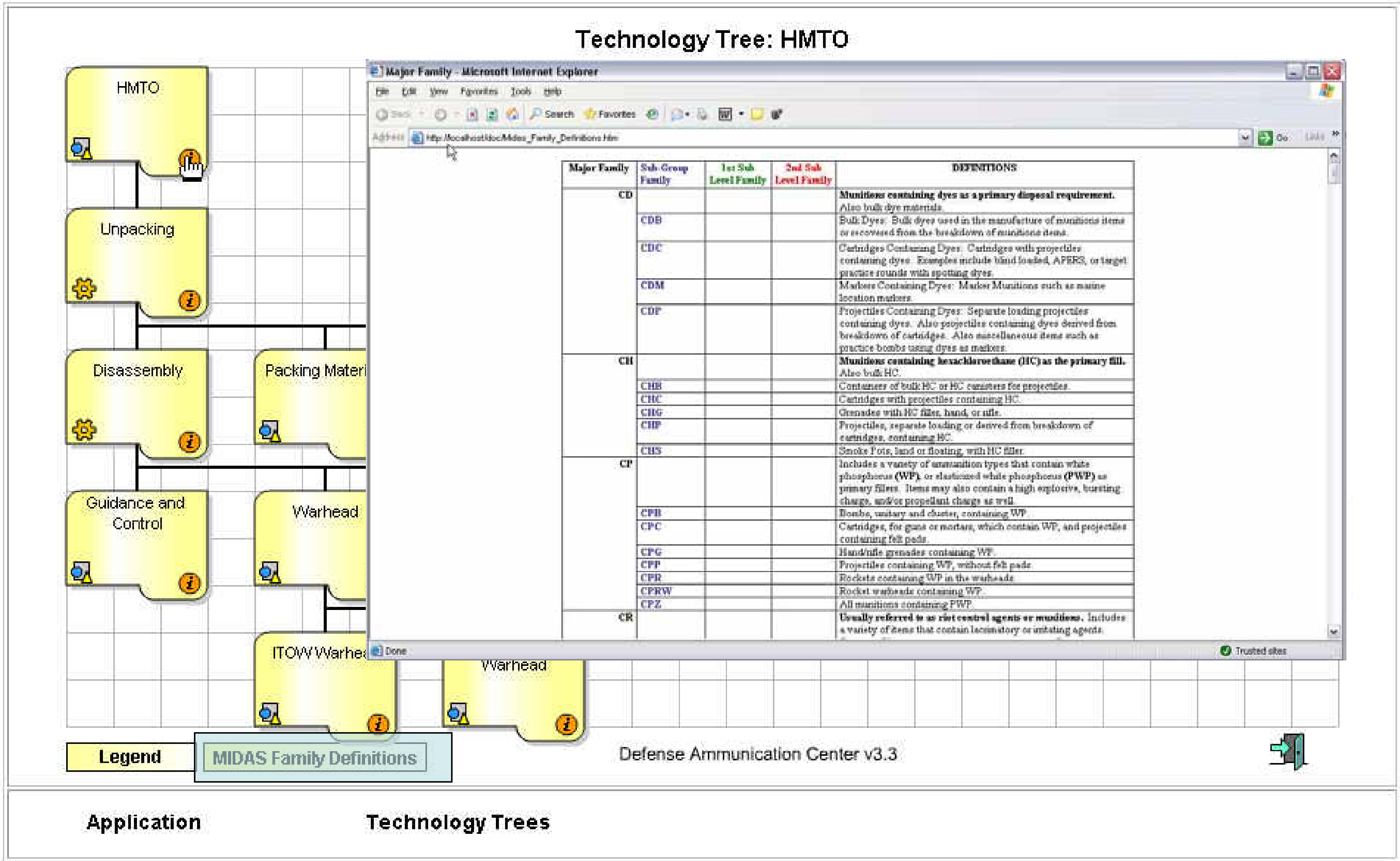
- Available via MIDAS website
  - https://midas.dac.army.mil
- Related Systems > Tech Trees
  - Register for Tech Tree account
- Currently working on single sign on
- Individual User Accounts
  - Only account holder has visibility



Access

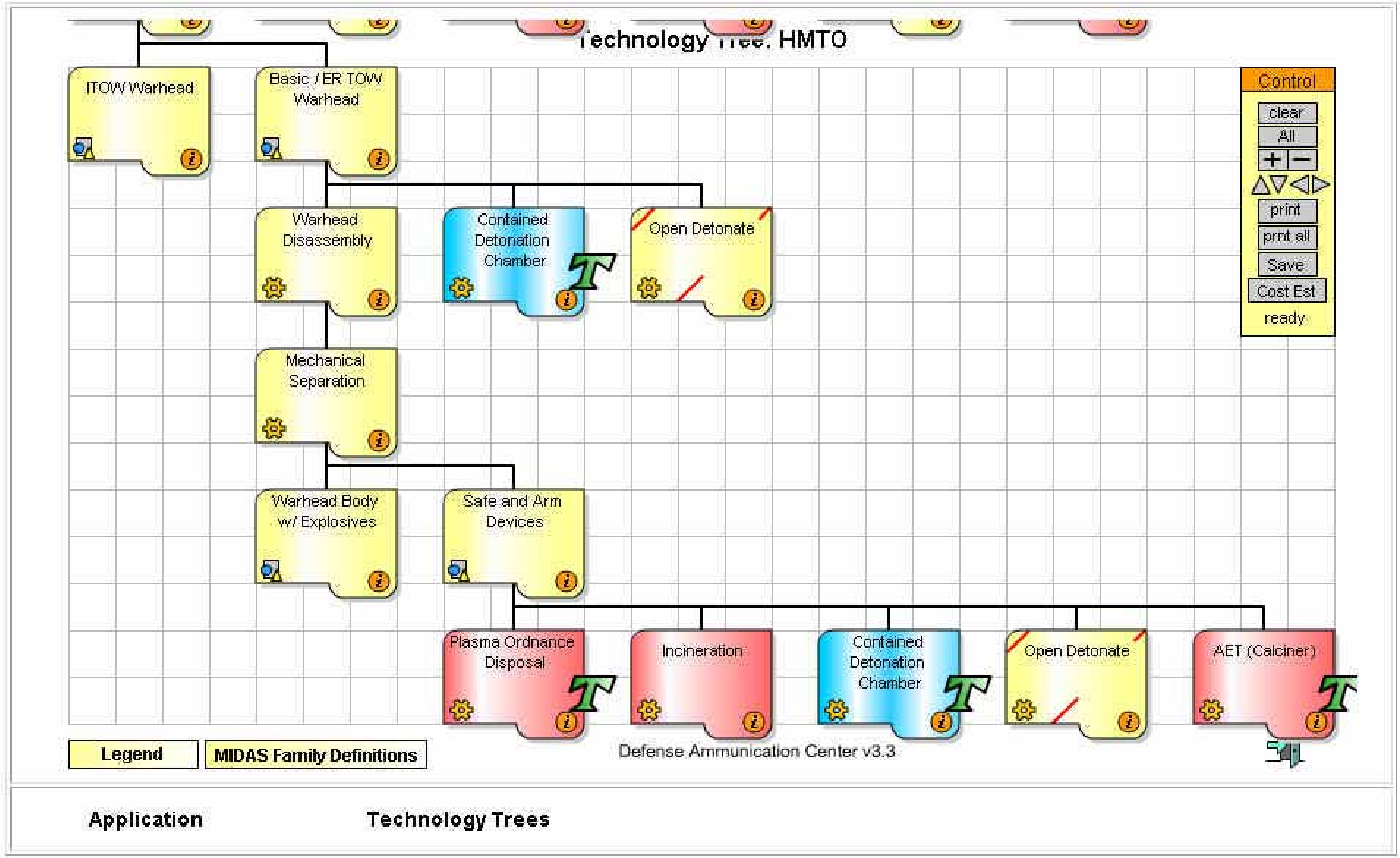

Select a Technology Tree to View from the Central Database
HBD
Submit
HBD
HMML
HMMV
HMSK
HMSP
HMTO
HMTT
HPCS
PCBL
PCBM
PCBMC
PCBS
PCC
PDLA
PDLB
PDLC
SAO
Submit

Application

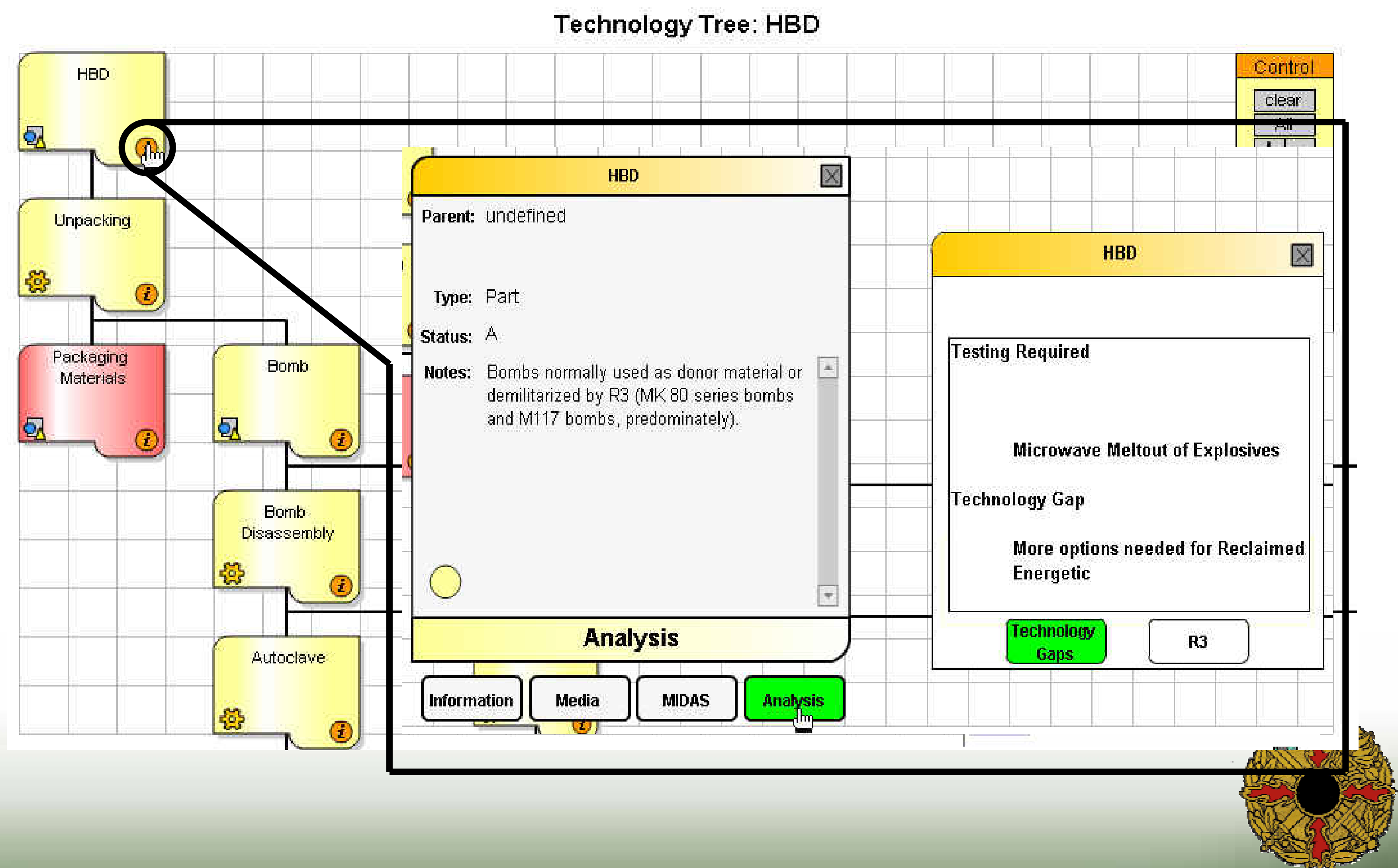


Major Family	Sub-Group Family	1st Sub Level Family	2nd Sub Level Family	DEFINITIONS
CD				**Munitions containing dyes as a primary disposal requirement.** Also bulk dye materials.
	CDB			Bulk Dyes: Bulk dyes used in the manufacture of munitions items or recovered from the breakdown of munitions items.
	CDC			Cartridges Containing Dyes: Cartridges with projectiles containing dyes. Examples include blind loaded, APERS, or target practice rounds with spotting dyes.
	CDM			Markers Containing Dyes: Marker Munitions such as marine location markers.
	CDP			Projectiles Containing Dyes: Separate loading projectiles containing dyes. Also projectiles containing dyes derived from breakdown of cartridges. Also miscellaneous items such as practice bombs using dyes as markers.
CH				**Munitions containing hexachloroethane (HC) as the primary fill.** Also bulk HC.
	CHB			Containers of bulk HC or HC canisters for projectiles.
	CHC			Cartridges with projectiles containing HC.
	CHG			Grenades with HC filler, hand, or rifle.
	CHP			Projectiles, separate loading or derived from breakdown of cartridges, containing HC.
	CHS			Smoke Pots, land or floating, with HC filler.
CP				Includes a variety of ammunition types that contain white phosphorus **(WP)**, or plasticized white phosphorus **(PWP)** as primary fillers. Items may also contain a high explosive, bursting charge, and/or propellant charge as well.
	CPB			Bombs, unitary and cluster, containing WP.
	CPC			Cartridges, for guns or mortars, which contain WP, and projectiles containing felt pads.
	CPG			Hand/rifle grenades containing WP.
	CPP			Projectiles containing WP, without felt pads.
	CPR			Rockets containing WP in the warheads.
	CPRW			Rocket warheads containing WP.
	CPZ			All munitions containing PWP.
CR				**Usually referred to as riot control agents or munitions.** Includes a variety of items that contain lacrimatory or irritating agents.

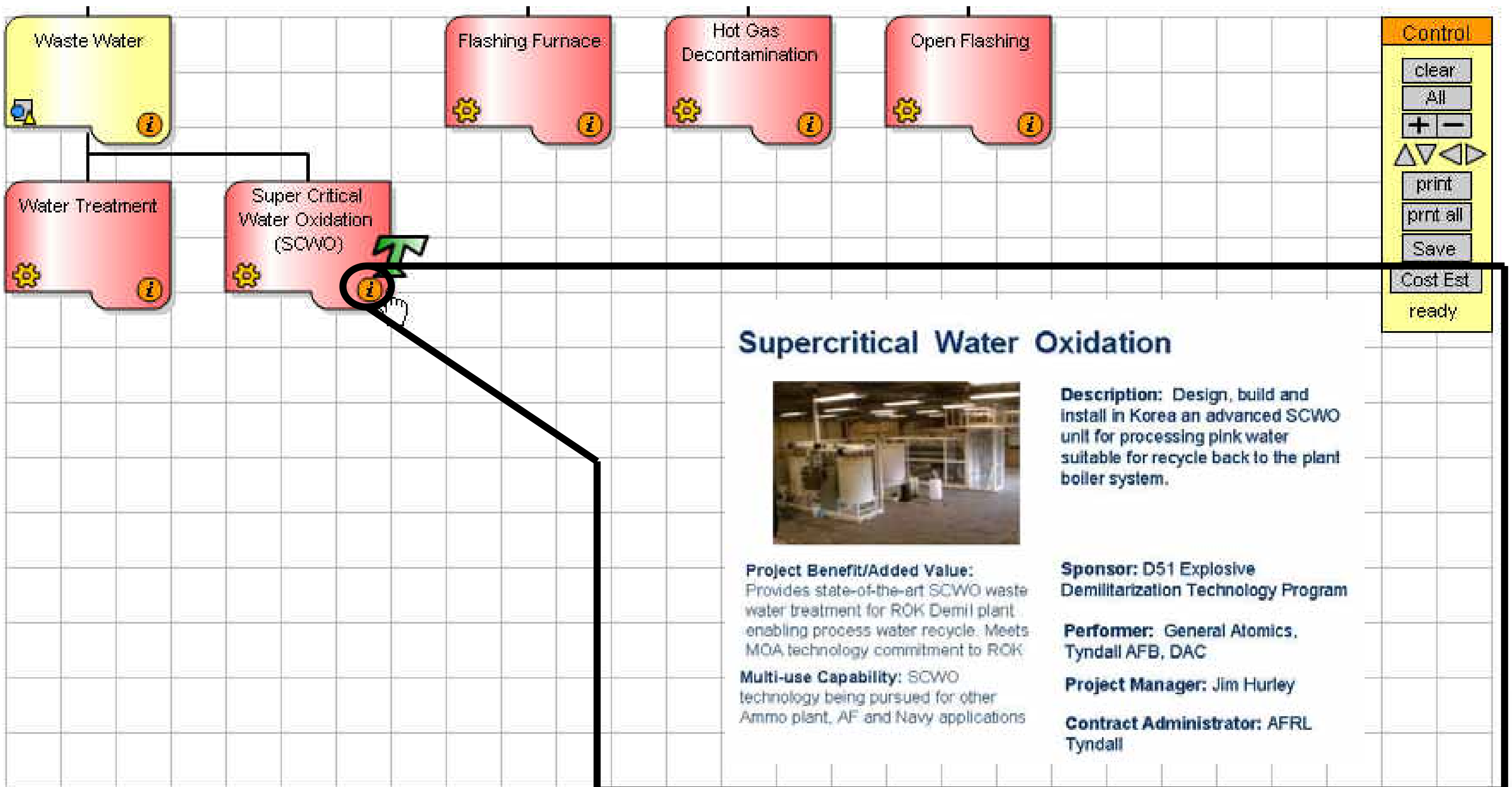
Application – Information Visualization



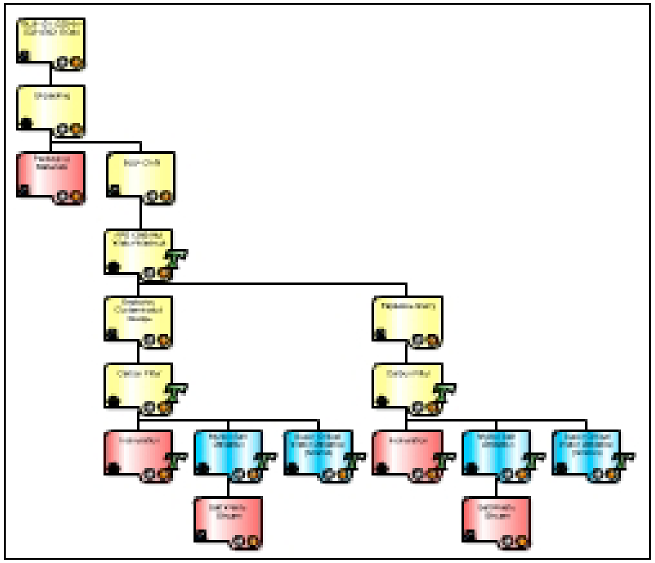
Application – Information Access



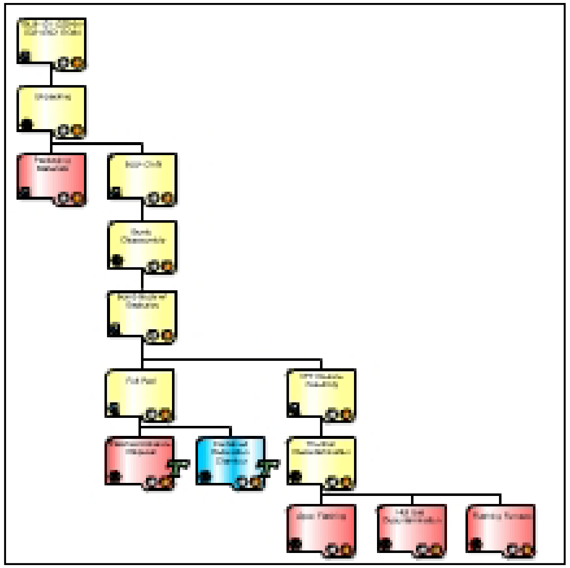
Application - Technology Summaries

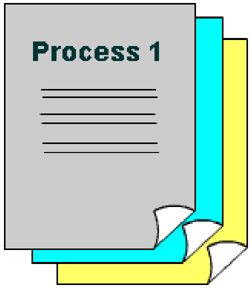


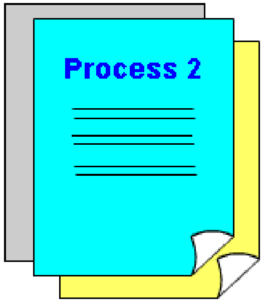
Application - Nodal Analysis



verses

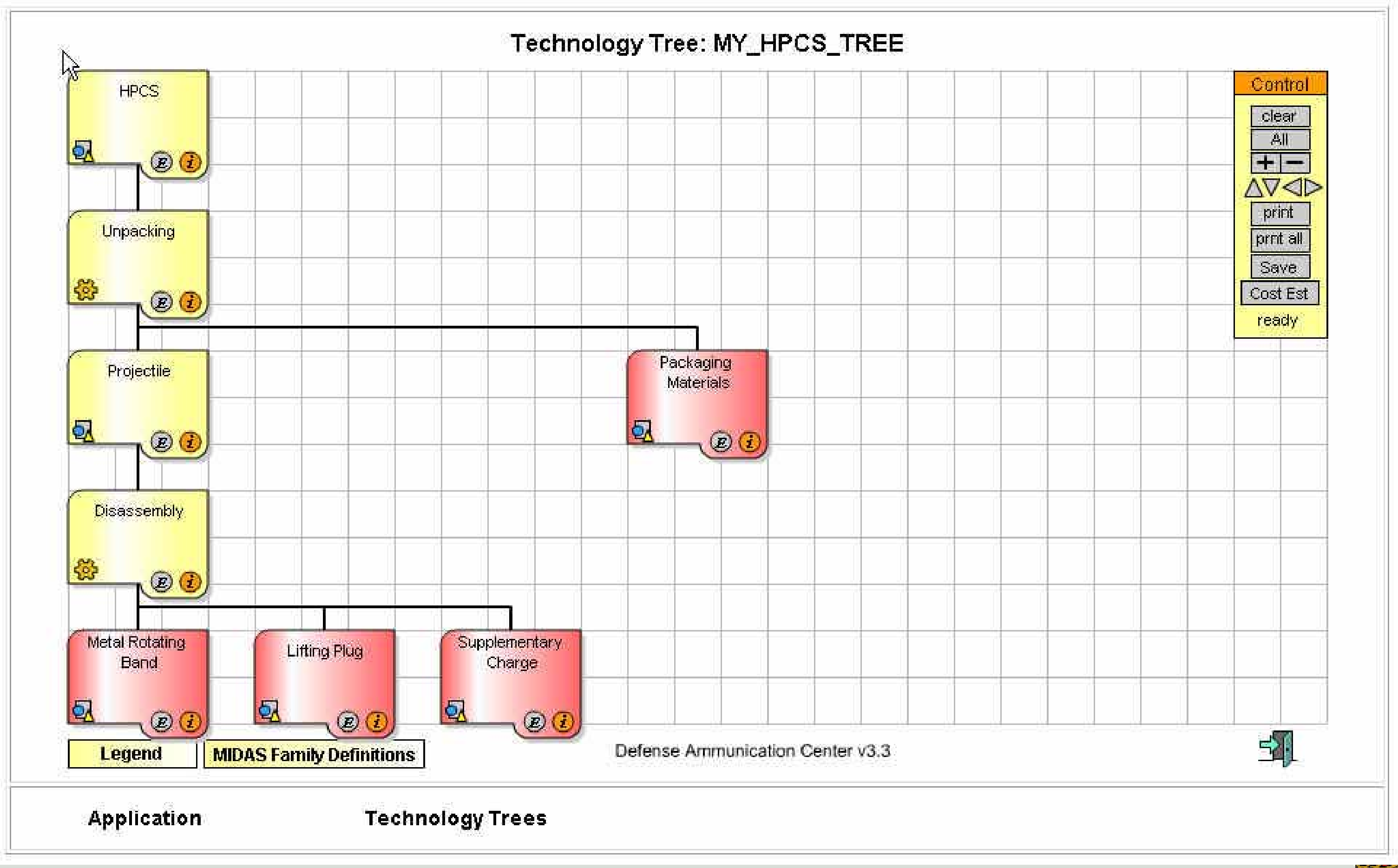




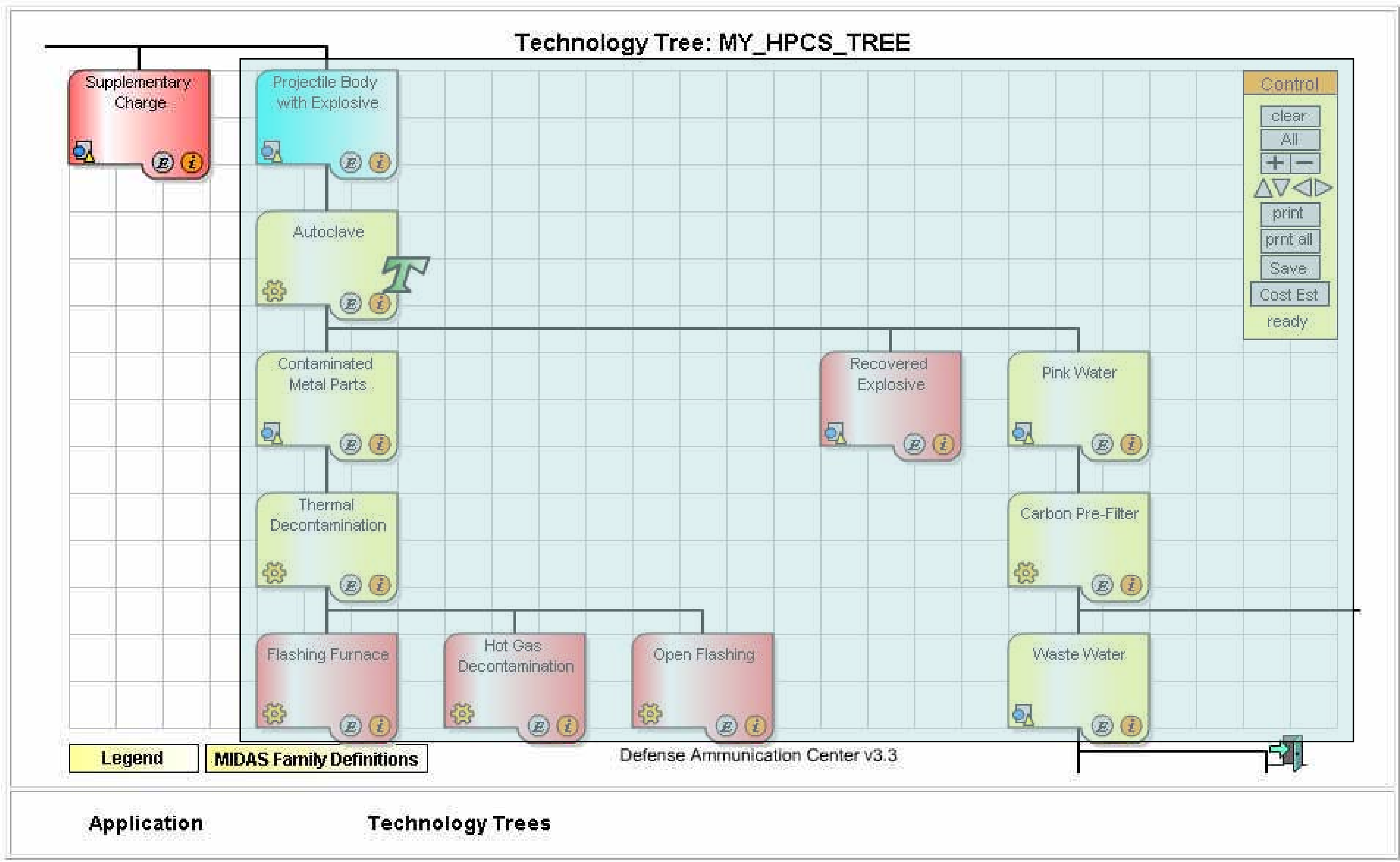


- Compare DEMIL processes and generate reports

Technology Tree Generation



Technology Tree Generation



Technology Tree Generation

- Process information comes from DEMIL community technical POC's, Technical Data Packages (TDP'S), and DEMIL plans
- Group meetings
  - Dynamic documentation of discussion
  - Clear visual presentation of information to group
- Online collaboration
  - Web-based application allows for distance communication with shared working document

Customers

DEMIL Planners

- Develop process flow charts from the Trees
- Incorporate the SOP operations within the tree
- Presentation tool during Hazard Analysis Work Groups (HAWGs)
- Bid building for DEMIL operations
- Identify technology gaps to request additional funding
- Identifying issues with Safety, Industrial Hygiene, and Environmental along with associated additional cost
- Continuity to fill gaps between personnel changes

Customers

Depot Environmental offices

- Demonstrate Demil processes to state and Federal EPA
  - Working to link application to EPA information and tools
- Advance time frame for permitting of future technologies
- Assist with finding additional funding to support the new activity
- Early anticipation of issues

Safety/Industrial Hygiene offices

- Identify and assess all risks and hazards
- Request additional funding to support the up coming missions with Safety and Medical capabilities

Customers

Ammunition Directors at Depots

- Facilitates familiarity with process and technologies
- Assist funding procurement to support the operation

Commanders and JMC

- Commanders can carry the fight for funding from JMC to support the added Technologies and DEMIL operations
- JMC - Set the priorities to also fight for funding to support environmentally friendly technologies from higher HQs
- JMC - Clearly assess cost and man hours associated with a bid

Summary

- Available now trough the MIDAS web site!
- Easily scalable!
  - Can be adapted to support…
    - Ammo Maintenance
    - Ammo Storage Operations
    - Design for DEMIL (DFD)
- Globally deployable!
- Provides centralized encapsulation of DEMIL community knowledge!
- Benefits majority of members of the DEMIL community!

Questions

Contact Information

Christopher DiLorenzo
Defense Ammunition Center
McAlester, OK 74501
918-420-8962
christopher.dilorenzo@dac.army.mil

Tactical Missile Recycling

"Establishing a Center of Excellence for Tactical Missile Recycling"

Mr. Jeff Wright
Dr. William S. Melvin
Mr. Jeff Lee
U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC)

2006 Global Demilitarization Symposium & Exhibition
1-4 May 2006

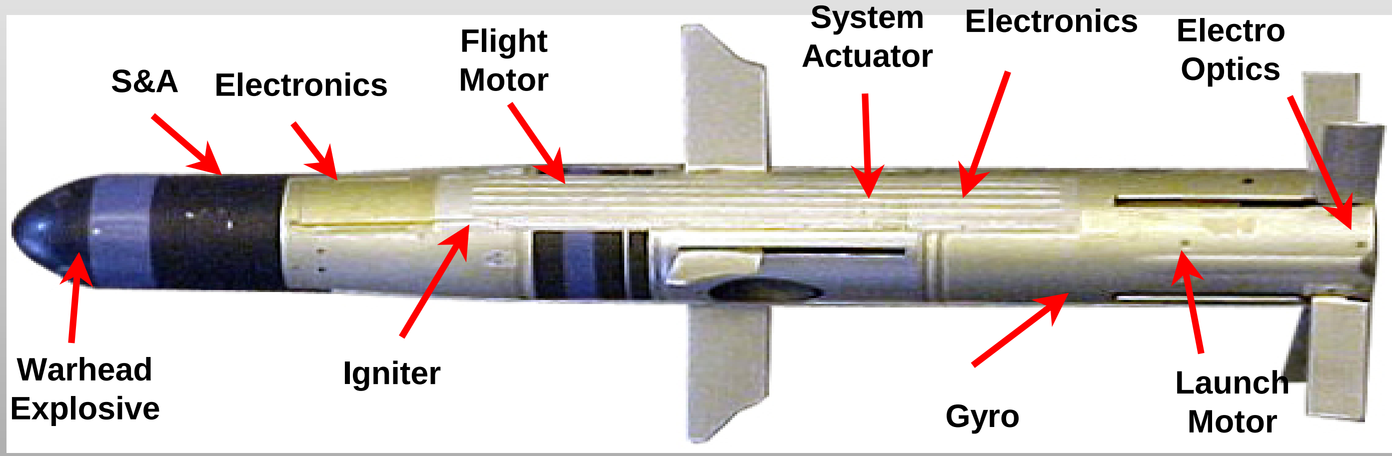
Transitioning AMRDEC Technology to Production

Tactical Missile Recycling

Acknowledgements

What is a Missile Recycling Capability?

- >98% of TOW missile components are recyclable
  - Missile Warheads
  - Rocket Motor Propellants
  - Rocket Motor Cases
  - Rocket Motor Nozzles
  - Launch Tubes
  - Guidance & Control Components
  - Airframe Components
  - Shipping Containers



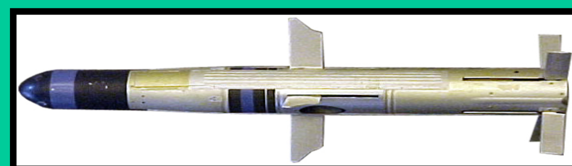
- Major MRC Modules
  - Missile Disassembly
  - Rocket Motor Denozzling
  - Propellant Removal
  - Warhead Explosive Removal
  - Energetics Size Reduction
  - Energetics Processing
  - Slurry Explosive Manufacturing
  - Hardware Decontamination
  - Material Handling & Shredding Equipment
  - Component Reuse

Missile Disassembly Operations

Warhead Billet Press-out Machines

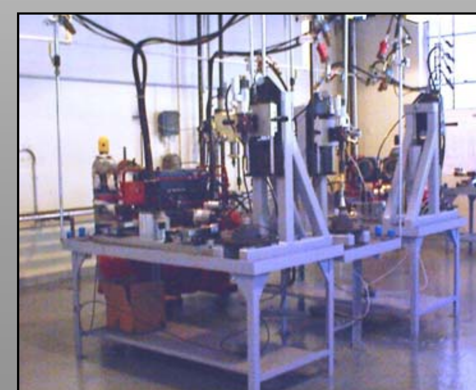
Launch Motor Denozzling Machines

ADMC Missile Recycling Center



TOW Missile System Recycling

Warhead Billet Splitting Machines



Flight Motor Denozzling Machines

- **Resource Recovery and Recycling (R^3) Minimizes Air, Ground, & Water Contamination**
- **Recycling Provides Low Cost Components for Project Office Reuse**

AMRDEC Technology Transition to Production at the ADMC

Removal of Missile from Launch Tube

Removal of Crush Switch and Probe from Warhead

Removal of Warhead from Missile

Removal of Flight Motor from Missile

AMRDEC Technology Transition to Production at the ADMC

TOW Launch Motor Denozzling Machine

TOW Flight Motor Denozzling Machine

Warhead Billet Removal Machine

TOW Igniter Assembly Removal Machine

ADMC MRC Production Facility

- Processed 5,085 TOW missiles during FY03 LRIP
- Processed 9,640 TOW missiles during FY04
- Processed 14,944 missiles during CY05
- Scheduled to process 13,408 missiles during FY06

MRC Denozzling Module

Launch Motor Denozzling

Flight Motor Denozzling

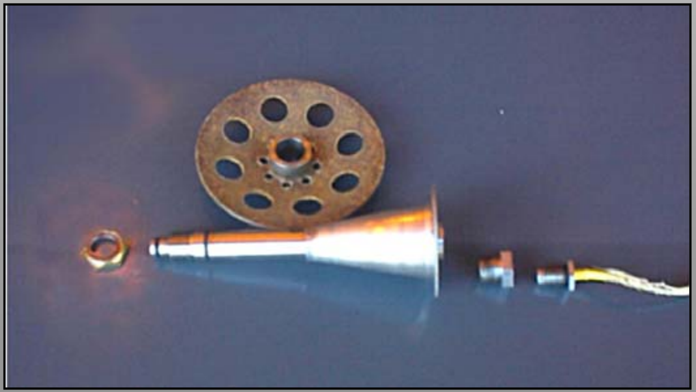
- **Removes aft closure (nozzle) from forward motor section**
- **Provides access to rocket motor propellants**
- **Damage free recovery of motor hardware**

MRC Propellant Removal Module

TOW Squib & Retaining Nut Removal Machine

TOW Igniter Assembly Removal Machine

Recovered TOW Double Base Cartridge-Loaded Grain



Squib and Igniter Assembly Components

MRC Propellant Removal Modules

Vertical Milling Machine

Typical Propellant Chips

- Removes <99% of the propellant from the rocket motor case

MRC Warhead Explosive Removal Module

Warhead Billet Removal Machine

Warhead Billet Splitting Machine

- Removes entire explosive warhead billet from outer casing
- Separates warhead explosive from shaped charge liner

ADMC MRC Component Reuse

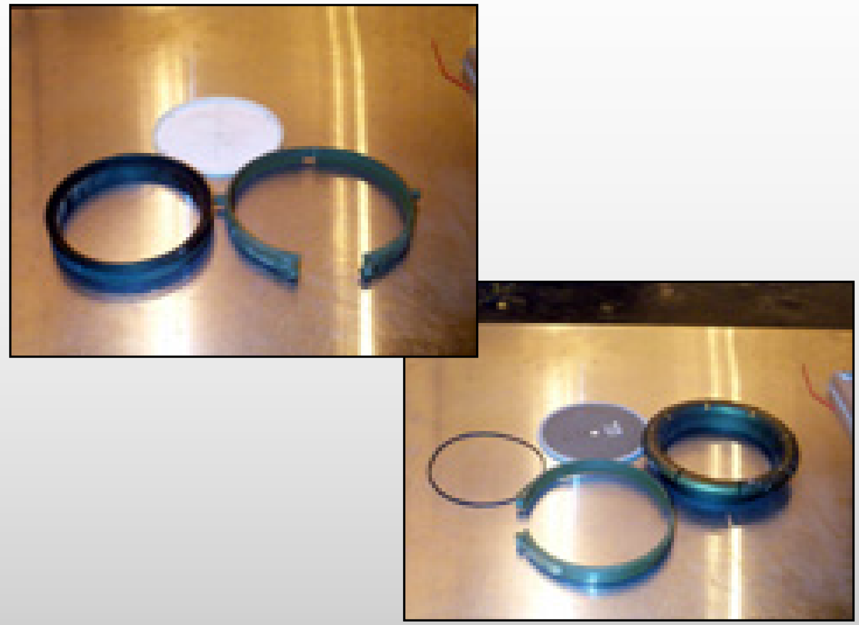
Visual/Physical Inspections
Performed on Each Launch Tube

Automated System for Validating
Electrical Wiring and Connectors

Capstan Wire Cutter Assembly
Check-out

ADMC MRC Component Reuse

Launch Tube Reuse



Additional Launch Tube Parts for Reuse:

Forward Fixed Coupling
Flex and Retainer Seal
Aft Fixed Coupling
Forward Quick Release

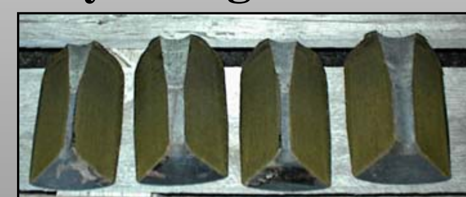
- Source of Supply for FMS & New Army Missile Builds
  - 2,858 launch tubes shipped to Raytheon, Inc. in FY 03-05
  - ~ 5,000 tubes and additional parts to be shipped for reuse FY 06-07
- Source of Supply for Operation Iraqi Freedom
  - 3,024 missile boxes & missile packing inserts
  - 1,700 forward end covers and extension rings

MRC Energetics Size Reduction Module

Launch Motor Propellant Shear Machine

TOW Flight Motor Grains Before Splitting

TOW Grain Splitter Currently Being Fabricated



TOW Flight Motor Grains After Splitting

- Currently installing SRM equipment and controls
- Scheduled to begin operations in 4th QTR. FY 06

MRC Energetics Size Reduction Module

LX-14 Before Size Reduction

TOW Rocket Motor Grains Before Size Reduction

Energetics Size Reduction Machine for the ADMC

LX-14 After Size Reduction

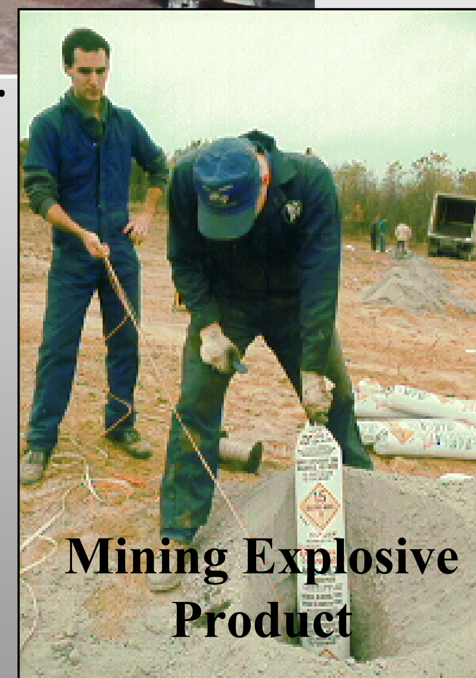
TOW Rocket Motor & Igniter Grains After Size Reduction

- Reduces the size of recovered bulk energetic materials
  - Warhead, flight motor, launch motor, & igniter grains
- Provides granulated feedstock for EPM and SEM operations

MRC Slurry Explosive Module (SEM)

Building 65, Designated SEM
Site at the ADMC

Slurry Mixer



Mining Explosive
Product

- Incorporates ~25% low value energetic material into a commercial slurry explosive
- All major components and tanks received at the ADMC
- Component installation and integration scheduled to begin May 06

MRC Slurry Explosive Module (SEM)

Slurry Mixer

Solution Tank

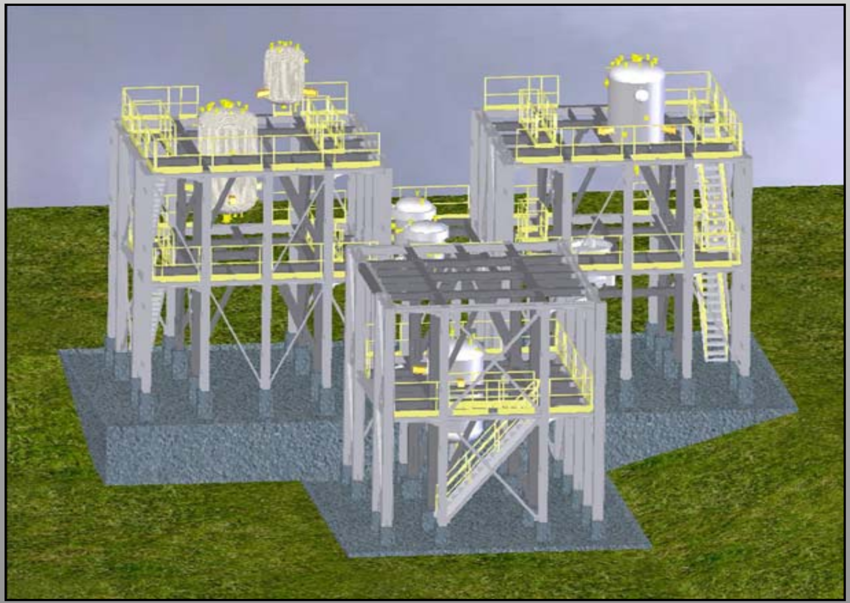
AN Screw Conveyor

Construction of Containment Pit for Solution Tank

MRC Energetics Processing Module
(Recovers HMX, RDX, AP)

Front View

Side View, Lower Rear



Structural Modeling of EPM

MRC Hardware Decontamination Module

Copper cones prior to flashing furnace

Copper cones after flashing furnace

- Transportable Flashing Furnace decontaminates missile hardware components to 5X cleanliness
- DAC funded / El Dorado Engineering manufactured
- Began operations at the ADMC in FEB 06

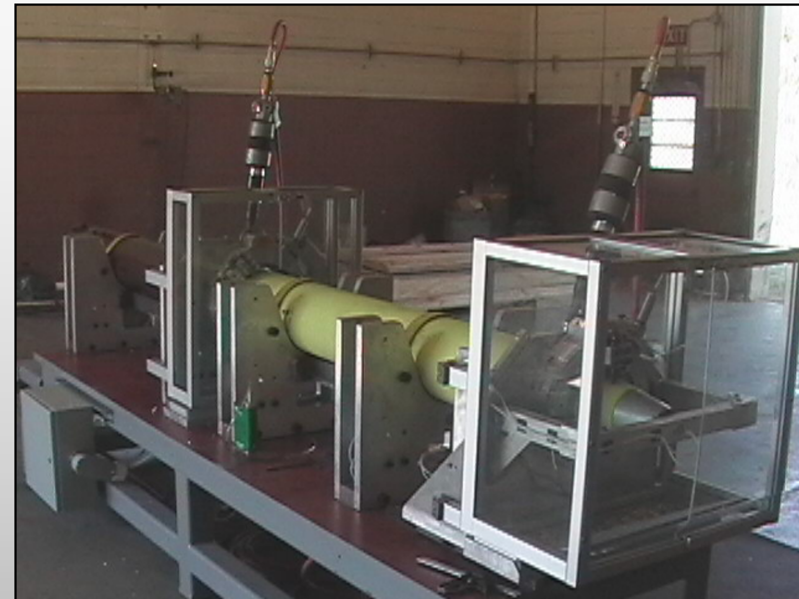
AMRDEC MLRS Recycling

(FY 04-06 RDT&E)

AMRDEC MLRS Recycling

MLRS Unloading

ADMC Bldg. 670



MLRS Warhead/Rocket Motor Separation Station

- Designed, fabricated, and tested MLRS pod downloading & warhead/motor separation equipment at RSA

- Demonstrated technology at the ADMC SEP 05

AMRDEC MLRS Recycling
ADMC Demonstration Testing

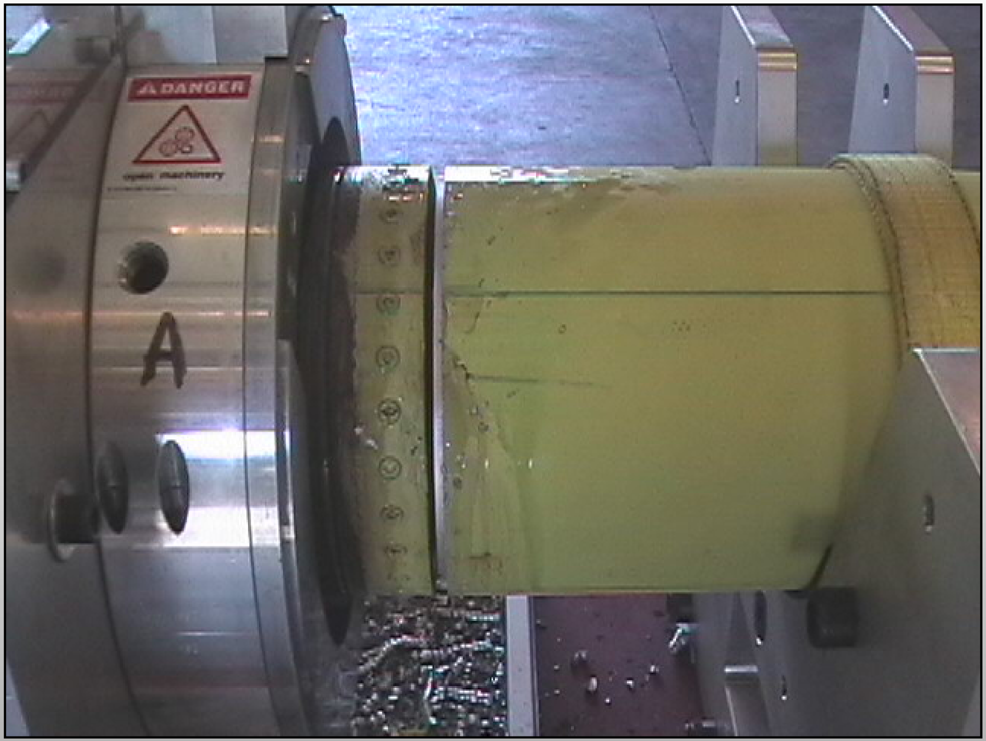
Removal of MLRS Rocket from the Pod

MLRS Rocket on the Transport Cart

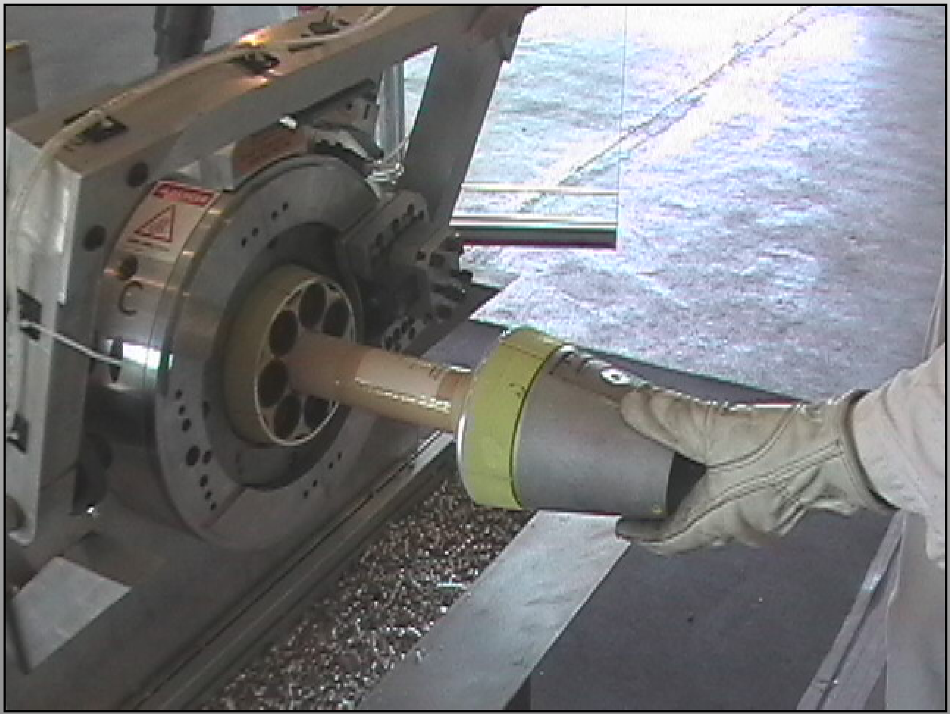
AMRDEC MLRS Recycling
ADMC Demonstration Testing

MLRS Warhead/Rocket Motor Separation Station

AMRDEC MLRS Recycling
ADMC Demonstration Testing

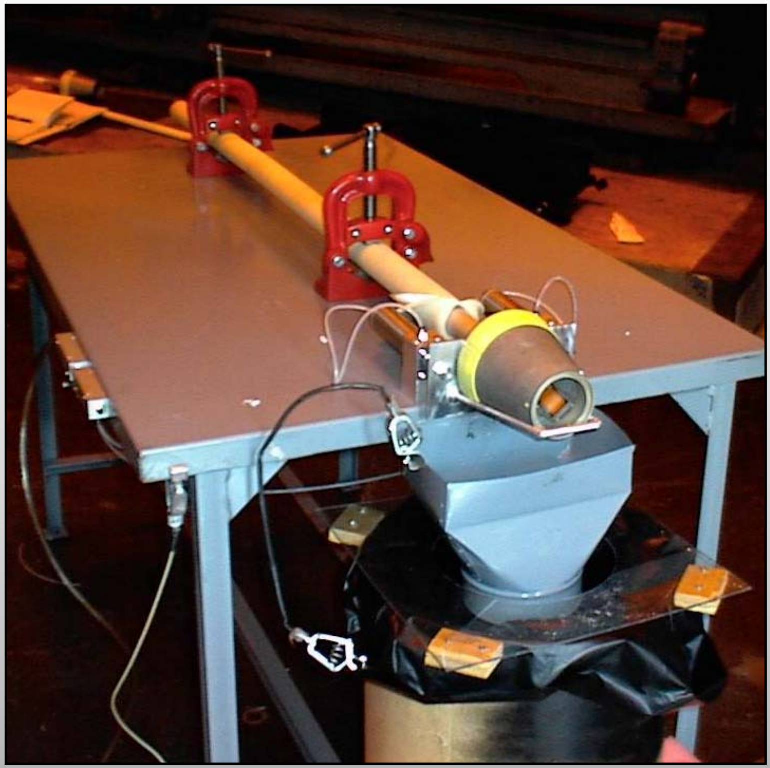


Separation of Warhead and Rocket motor after Cutting Operations

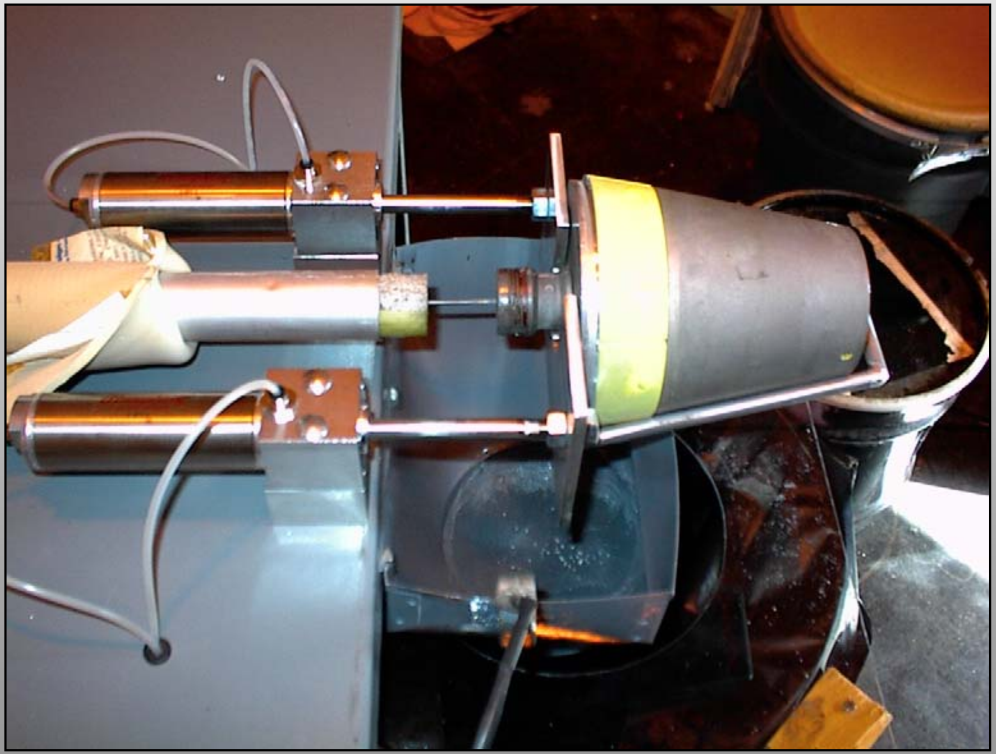


Removal of CCB after Cutting Operation

AMRDEC MLRS Recycling
RSA Demonstration Testing

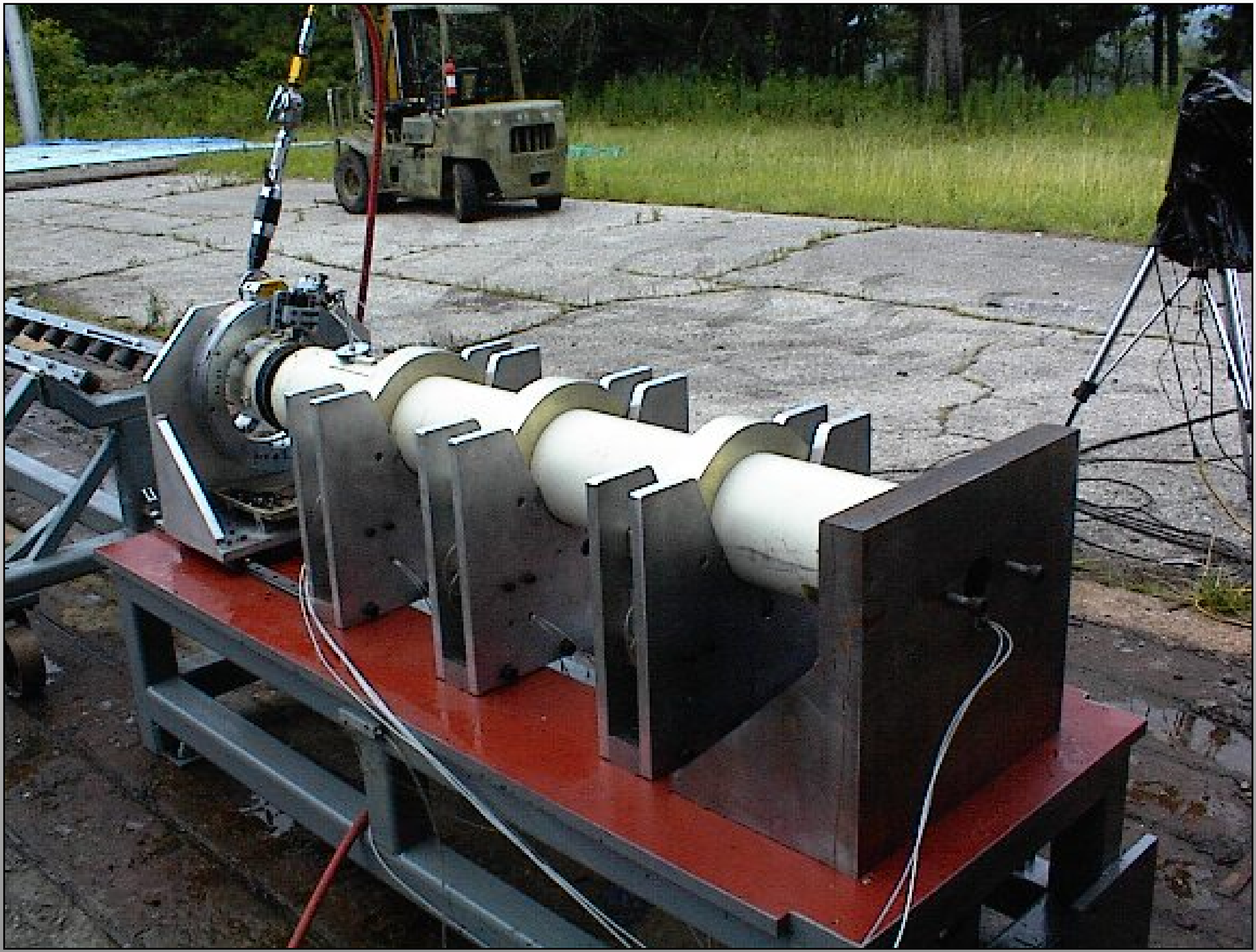


CCB Disassembly Station



CCB Forward End Plug/Bulkhead Removal

AMRDEC MLRS Recycling
RSA Demonstration Testing



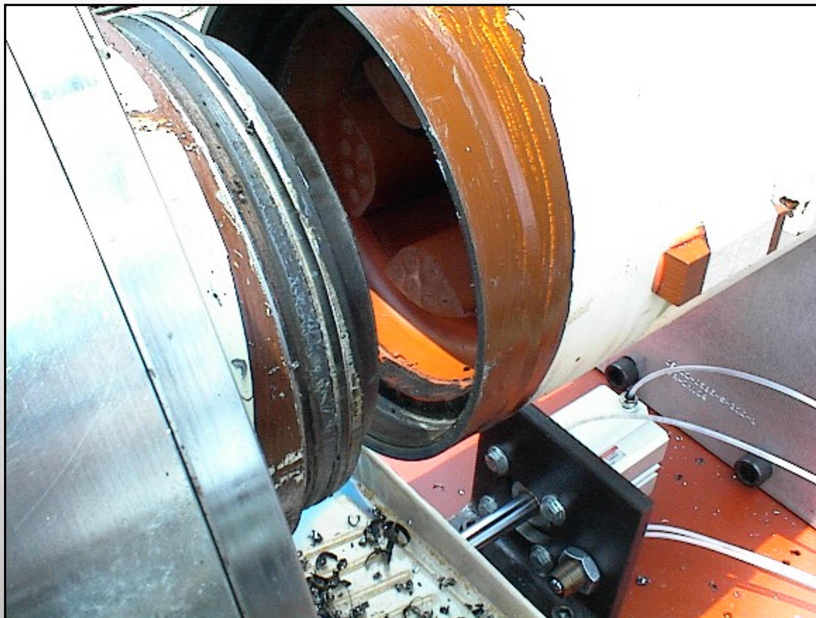
MLRS rocket motor secured in the Nozzle Removal Station

AMRDEC MLRS Recycling

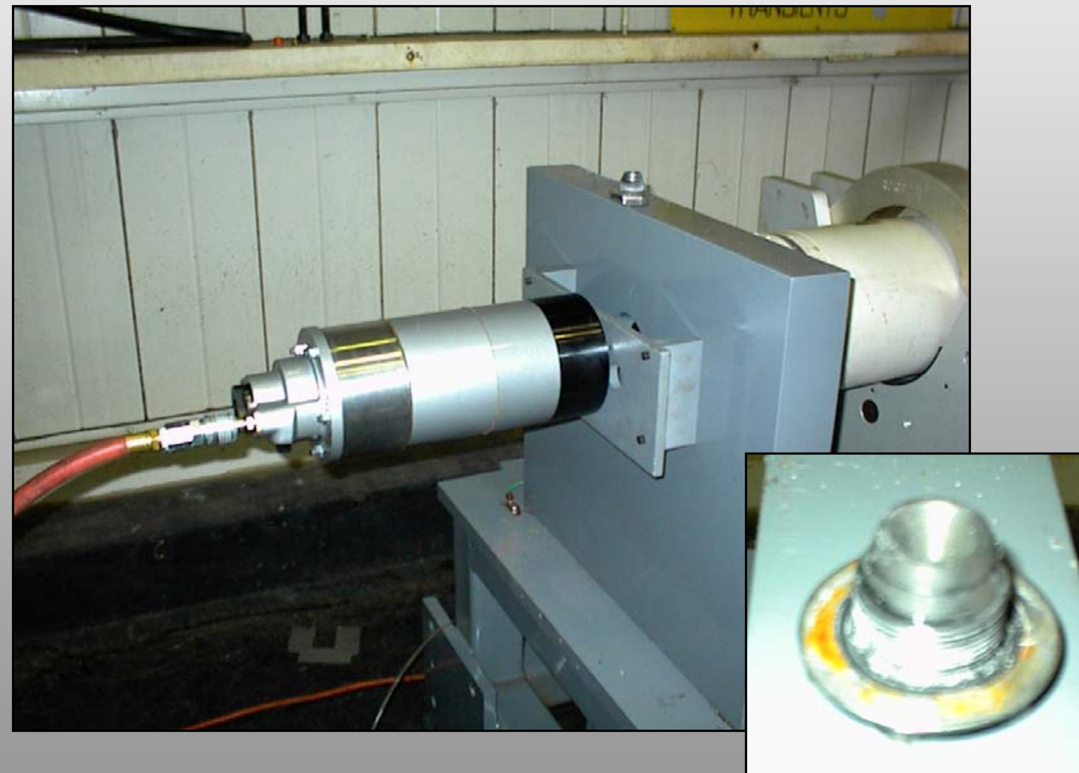
RSA Demonstration Testing

Thermal Image of Cut

AMRDEC MLRS Recycling
RSA Demonstration Testing



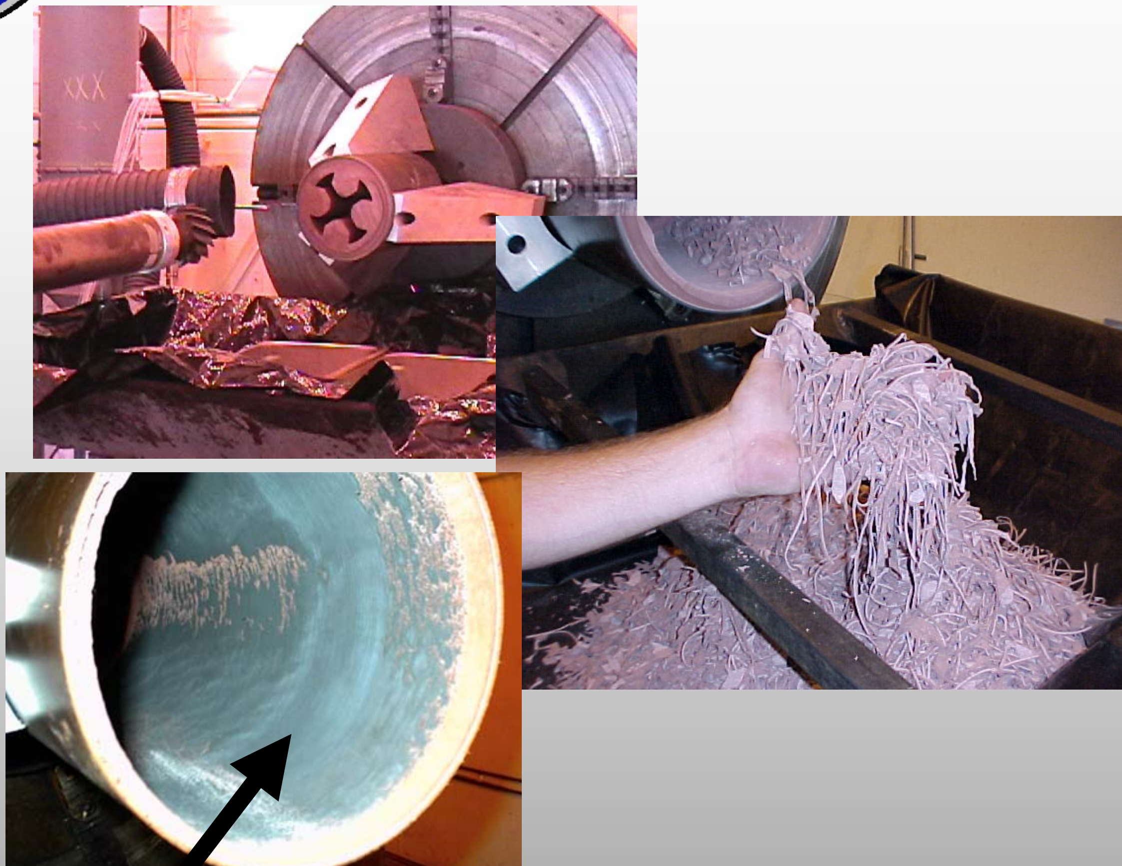
Nozzle extraction



Forward End Plug Removal Performed with Nozzle Removal Station

AMRDEC MLRS Recycling

Propellant Removal



Propellant & liner removed

- Develop & demonstrate MLRS rocket motor propellant machining

- Total structural dimensions: base- 20’ X 20’, height- 18’

Installation of Prototype MLRS Milling Station

Missile Warhead Disassembly

LEMC RDT&E

- Perform warhead R3 evaluations
- Demonstrate proto-type warhead disassembly fixtures
- Modify MRC energetics removal processes for warhead recycling

Harm

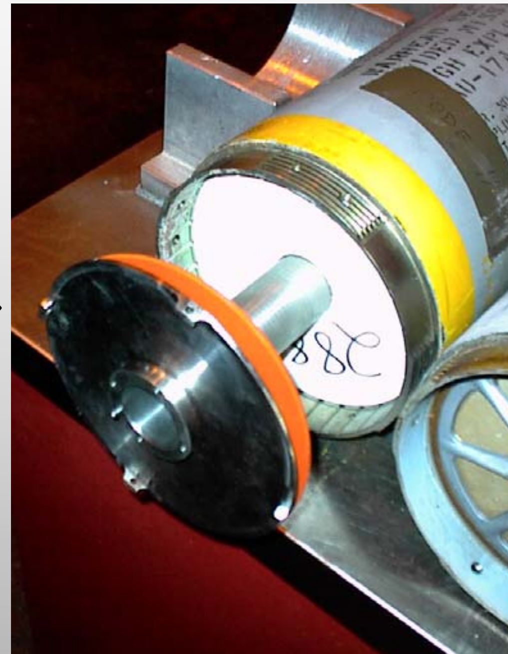
Phoenix

Sparrow

Shrike

Sparrow 17 A/B Warhead Disassembly
RSA Technology Demonstrations

Forward Closure Plate/Assembly



Remotely operated billet press-out machine

Recovered PBXN

Sparrow 10/B Warhead Disassembly
RSA Technology Demonstrations

Aft Support Removal

Bulkhead Cutting and Removal

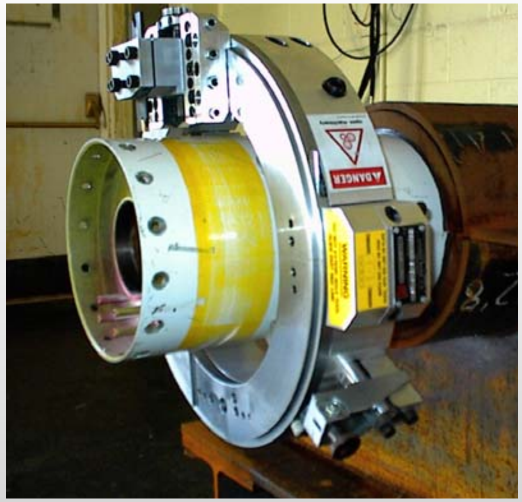
Imbedded Igniter Tube

Warhead in Press-out Machine

DATB billet and magnesium liner

Shrike Warhead Disassembly
RSA Technology Demonstrations

Shrike Warhead



Bulkhead Weldment Removal

Wire Harness Tube
Weldment Removal

Bulkhead and Igniter
Well Removal

Warhead Billet
Press Out

Recovered Billet and Hardware
Components

SUMMARY

- Missile recycling operations in Building 381 began early in 2003
  - ~ 32,000 TOW missiles processed to date
  - ~700,000 lbs. of scrap metal recycled to date

- >98% of missile components are recyclable into commercial and military reuse products
  - MRC is source of supply for missile launch tubes and end closure components
  - Investigating reuse/recycle of several other components

- MRC technology being developed and evaluated for MLRS
  - Production scale equipment fabricated and tested at Redstone Arsenal for MLRS

- MRC technology being developed and evaluated for missile warheads stored at the LEMC

Controlled Detonation "DA VINCH"

A Further Report on Kanda Port Chemical Weapons Project in Japan

Joseph Kiyoshi ASAHINA, Takao SHIRAKURA

May , 2006

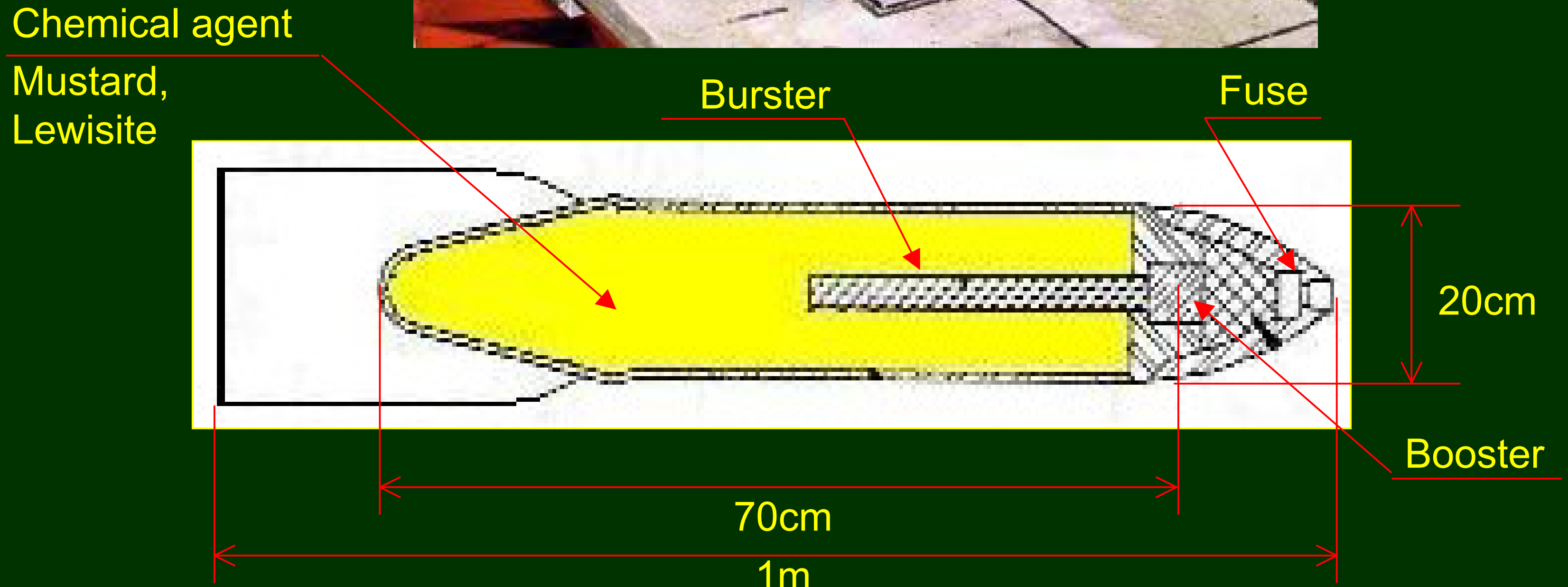
Kobe Steel, Ltd.

Kanda Port Project

- 2002: High Efficiency Magnetometer Detection
- 2003: Recovery system development of chemical
- munitions from the sea.
- 2004:～Construction, recovering , transportation destruction
  Environmental monitoring,
  Support of Public Acceptance.

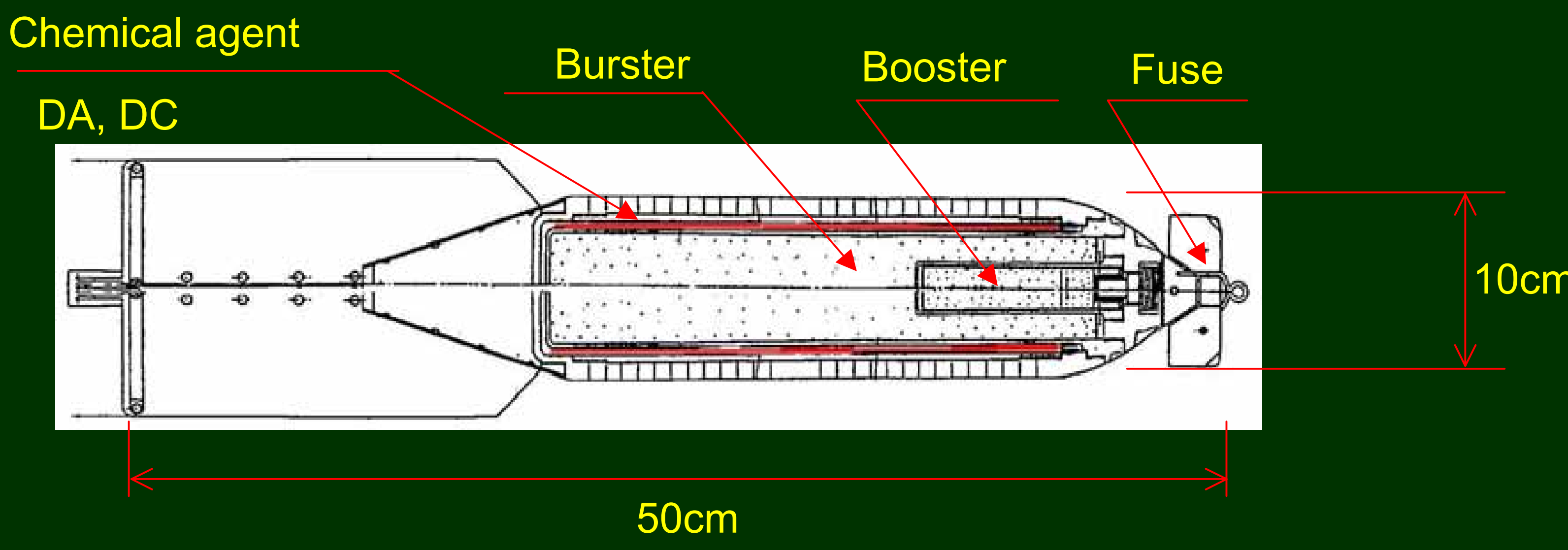
50kg Yellow bombs (HD+L) : 100

15ｋg Red bombs (Clark I,II)：500



50kg Yellow Bomb

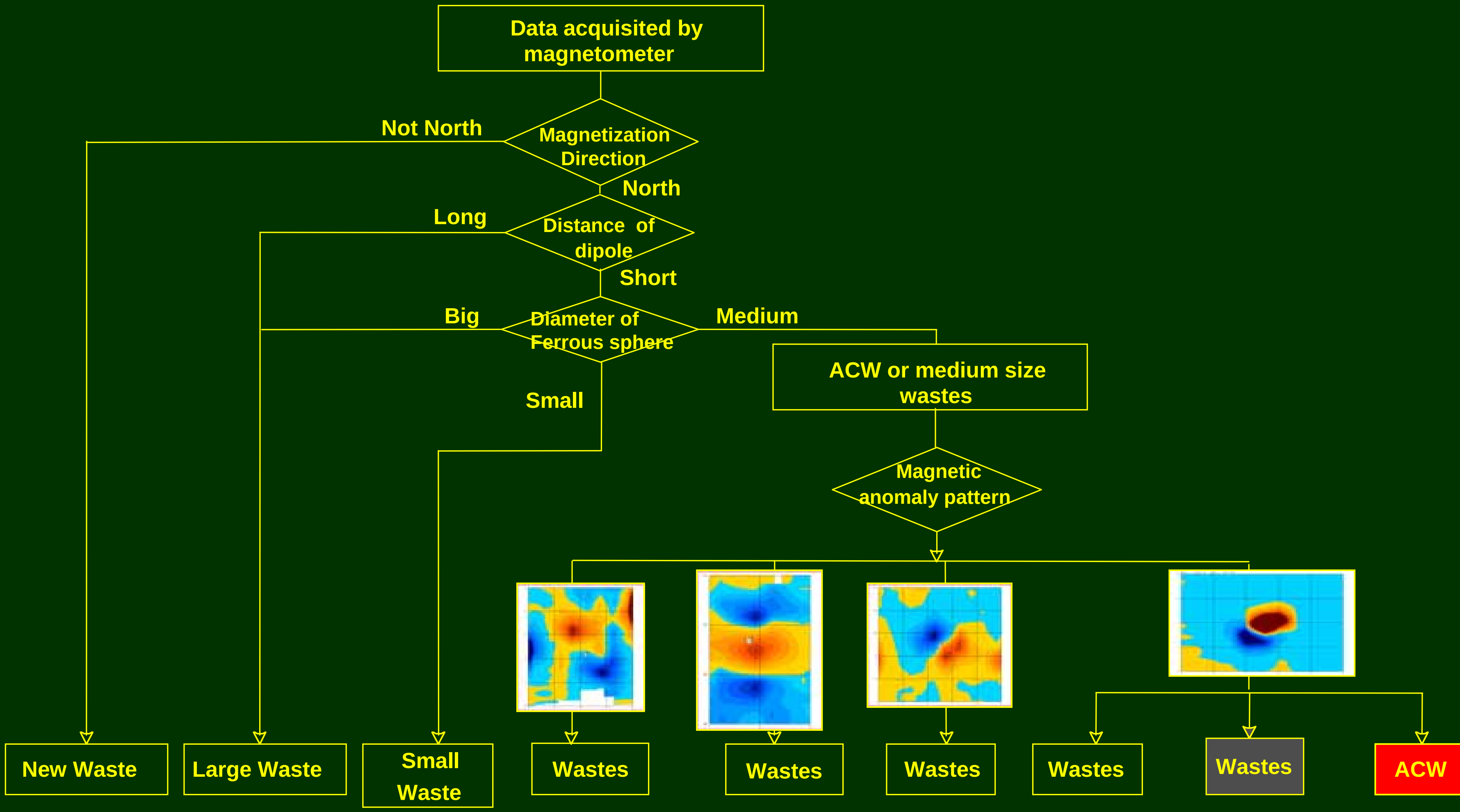
(HE:2.3kg, CA:18 L)



15kg Red Bomb

(HE:1.3kg , CA:368 g)

Multimagnetometer-detecting System with RKT/GPS



Identification Flow

Development of Anti Chemical Agent Diving System (ACADS)

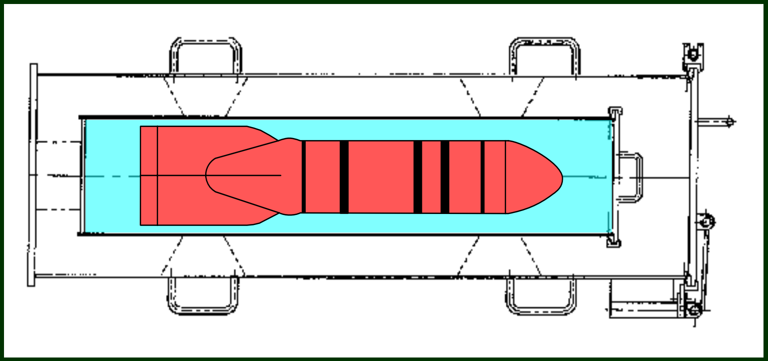
Test operation at training pool

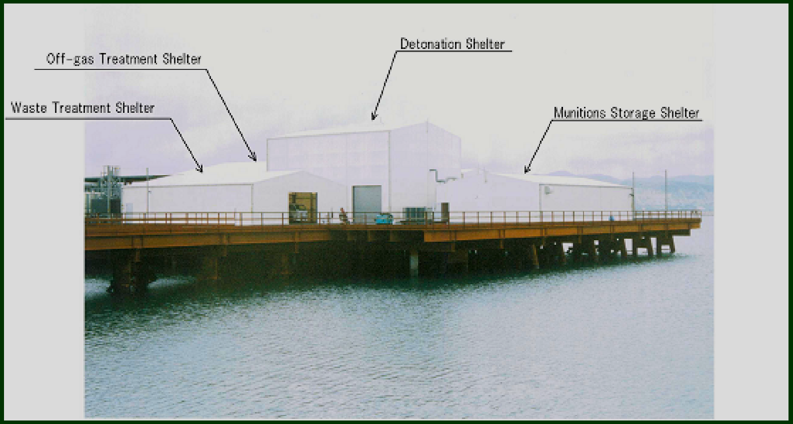
Air supply unit with CA filters

Actual operation at Kanda Port

Fuse Distinction and Identification System in the Sea

X-Ray in the sea, distinction of fuse away From the recovering site, Head Quarters of JDA





Double Walled Container

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Recovering Operation

CA Monitoring system for diving operation

Portable GCMS developed by LLNL

Recovered Containers on the Pontoon

Transportation Convoy to KWDF

DA VINCH™
Detonation of Ammunition in Vacuum INtegrated CHamber

DA VINCH^{TM} is

a Process of Controlled Detonation

What is Controlled Detonation?

Characteristics of DA VINCH

Structural Characteristics

1. Double-walled Structure
2. Multi-layered Outer Chamber

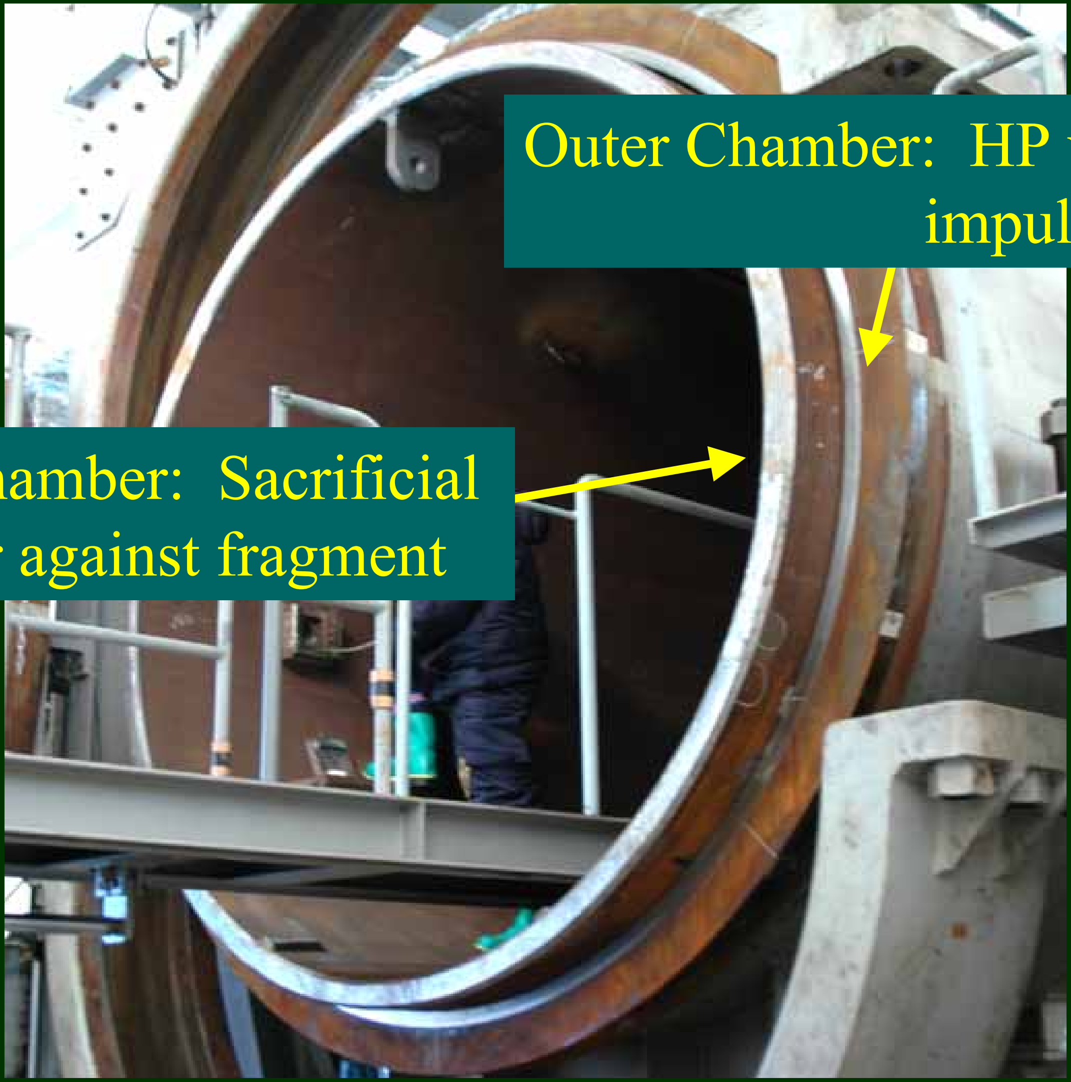
Operational Characteristics

1. Detonation in Vacuum with minimum Oxygen Supply
2. Implosion with Emulsion Explosive
3. Simultaneous Multi Detonation

Maintenance Characteristics

1 Structural characteristics

1) Double Walled structure with removable Inner Chamber



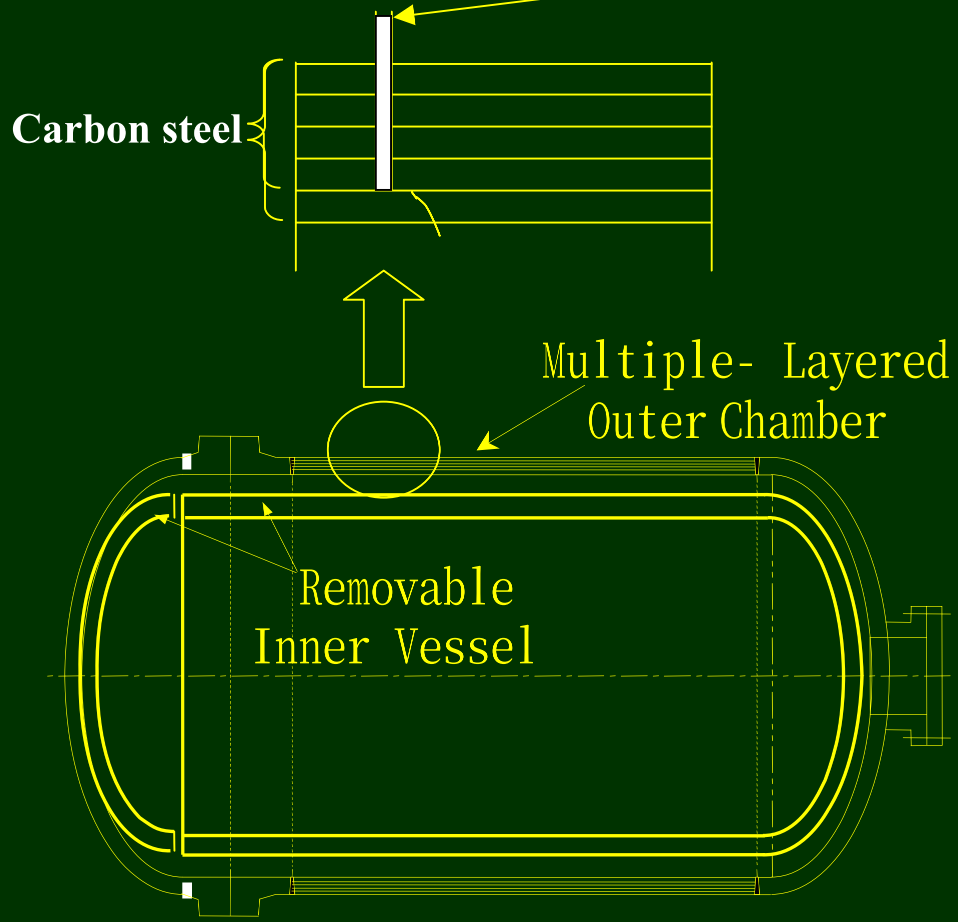
Outer Chamber: HP vessel against impulsive pressure

Inner Chamber: Sacrificial chamber against fragment

1 Structural characteristics

2) Multi-layered Outer Chamber

Detection hole to monitor the leakage from the 1st layer



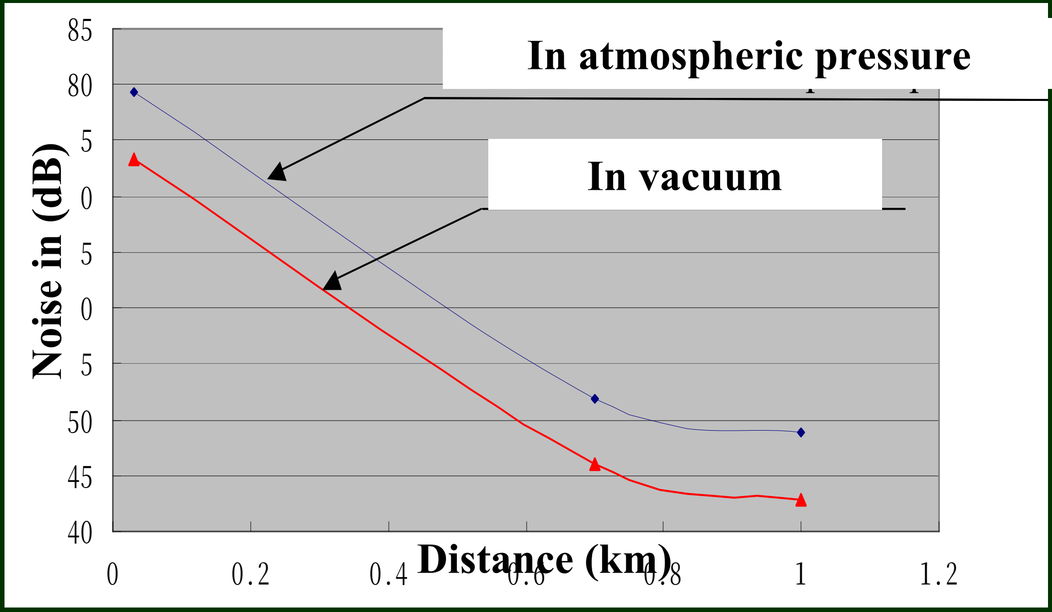
2 Operational characteristics

1) Detonation in Vacuum with minimum Oxygen Supply

(1) Reduction of impulsive load.

(2) Reduction of vibration and explosion sound,

(3) Keeping the internal pressure negative within 1 minute after detonation.



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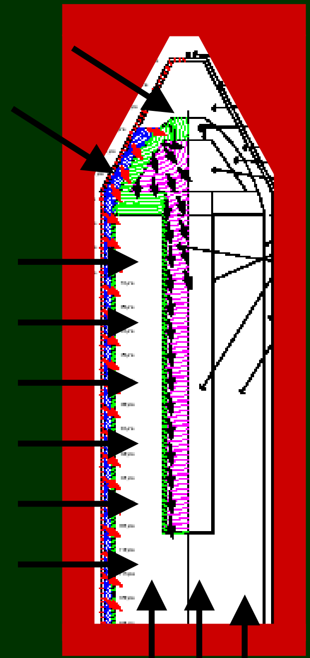
2) Emulsion Explosive as donor charge

(1) Easier composition control,

(2) Manufacturing on site, no storage, no transportation of explosive necessary.

3) Implosion by emulsion on munitions

(1) Reduction of speed and size of fragments provides the longer life to the chamber.

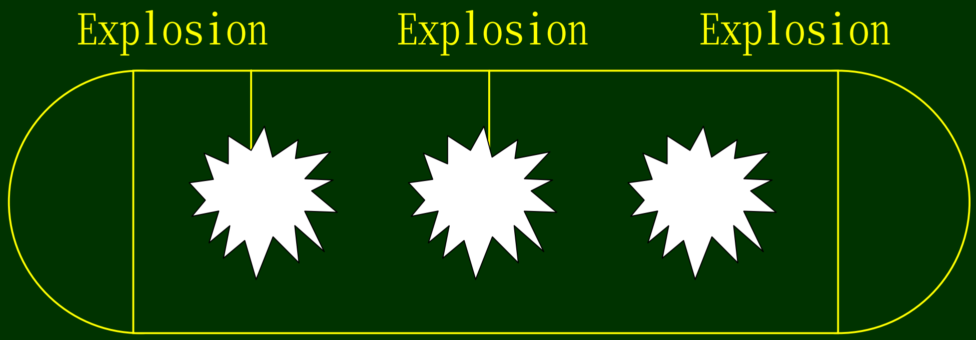


Yellow bomb with donor charge

2 Operation characteristics

KOBELCO

3) Simultaneous Multi Detonation



For higher throughput ⇨ No further development necessary,
To make the cylindrical part longer,
Welding on site under transportation limit,

Assembly on site

3 Easy direct maintenance

- No chemical agent Detected in Detonation off-gas
- DRE for off-gas > 99.9999%

Cleaning the flange automatically by robotic arm after detonation

KOBELCO

DRE (Destruction Removal Efficiency)

1) High　DRE

By utilizing explosive Energy for destruction of Chemical Agent

1)High Pressure=10GPa

2)High temperature=3000K

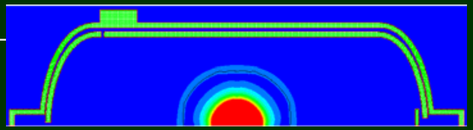
Detonation is a completely different process from incineration

	for off gas	for fragments and dust	cleansing shot before removal
DRE	**＞ 99.9999%**	**＞ 99.99%**	**<GPL**

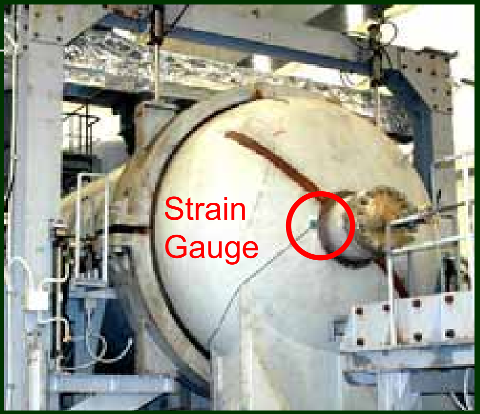
Operation Monitoring by DESTINY

FEM Dynamic Analysis

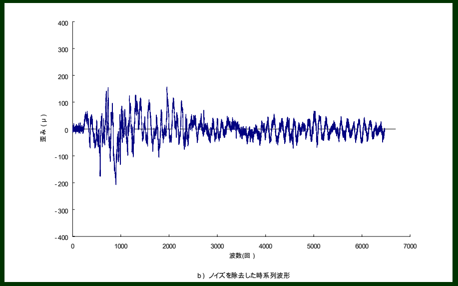
Selection of Points of Interest



Real-time Strain Measurement



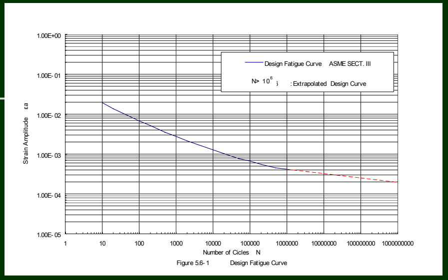
Preparation of Strain Wave by single Detonation



Calculation of cumulative Fatigue Damage $\Sigma n/N$ for single Detonation

Calculation of Total cumulative Fatigue Damage $\Sigma\Sigma n/N$ for all experienced Detonations

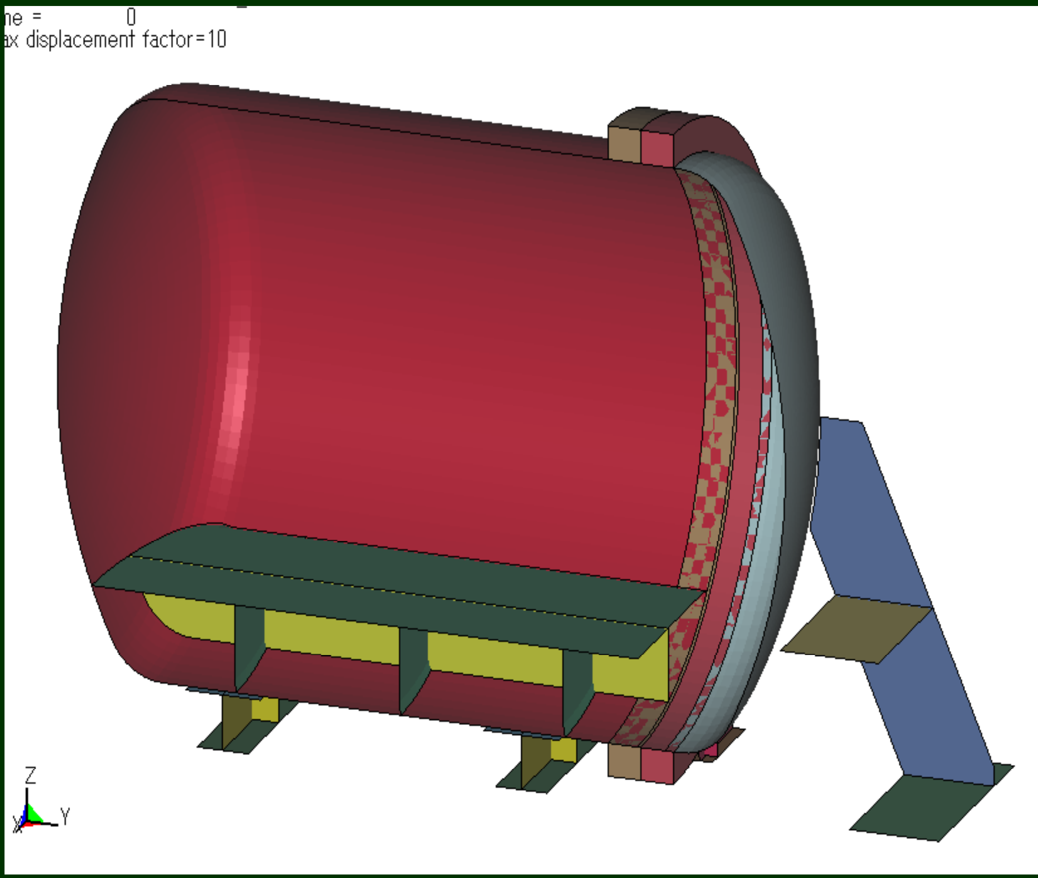
Monitoring of crack initiation



Information for scheduling of Maintenance/Replacement

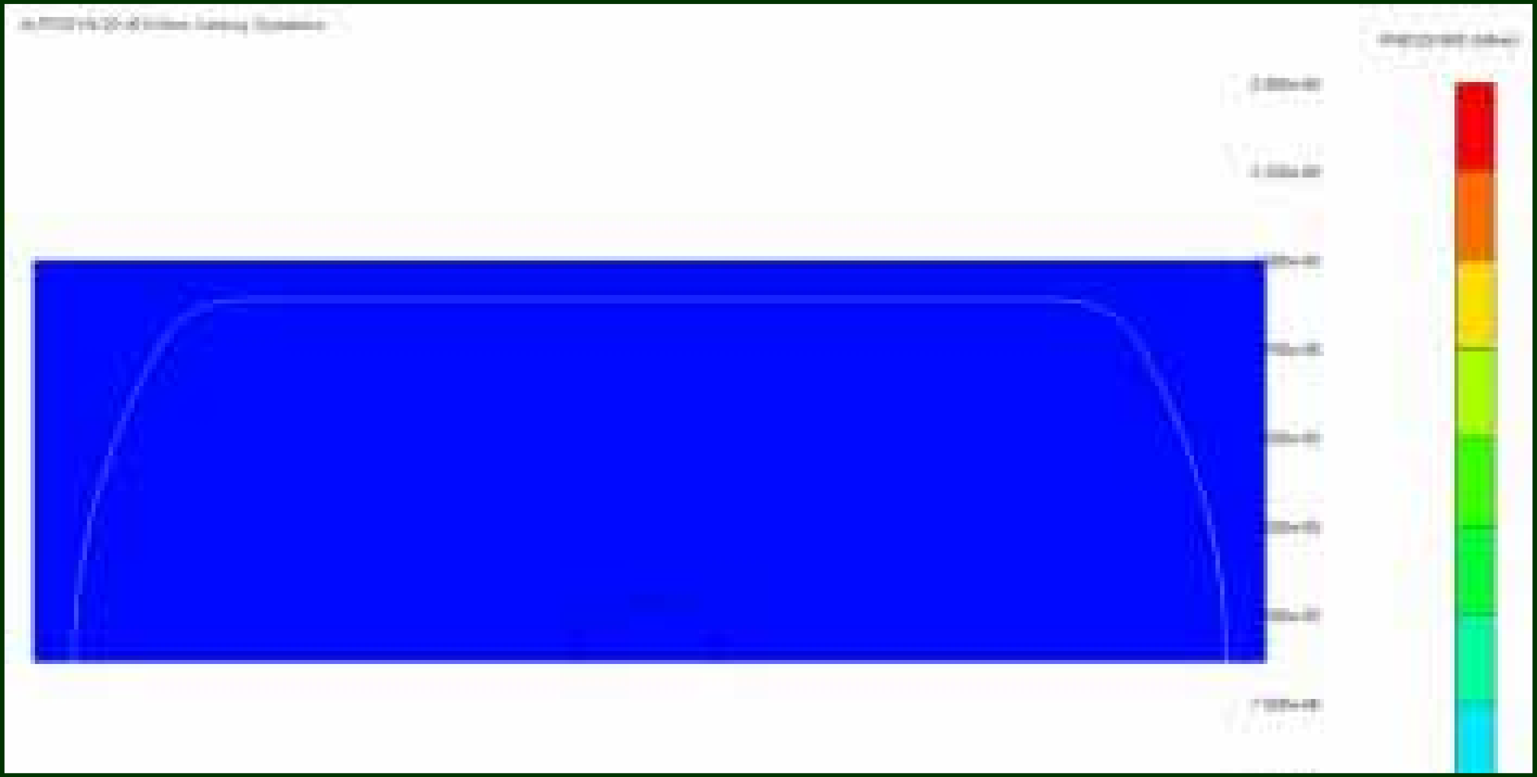
Verification of Dynamic Analysis
1) Single walled transportation chamber

Explosion Experiment Setting, TNT : 2.2kg

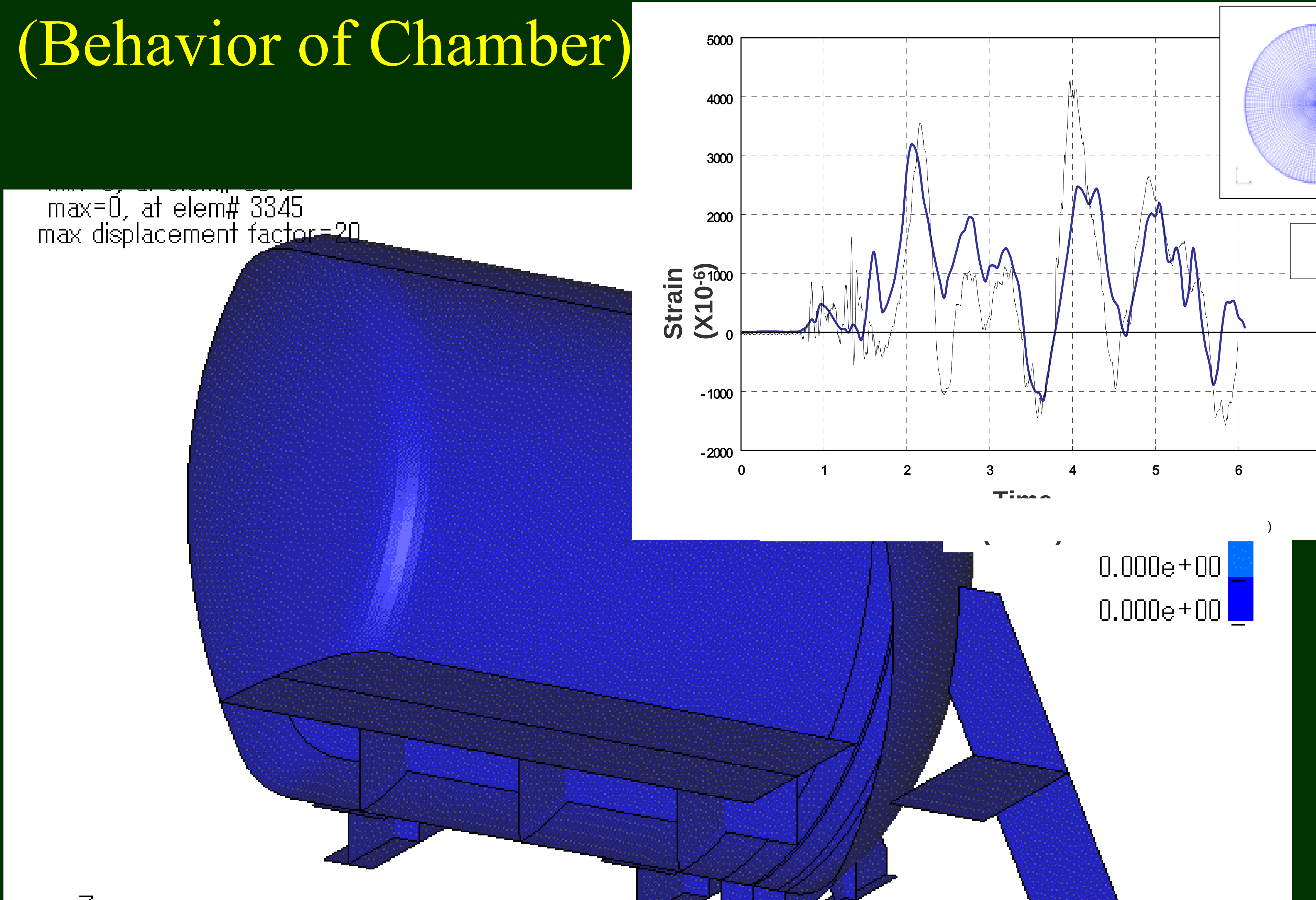


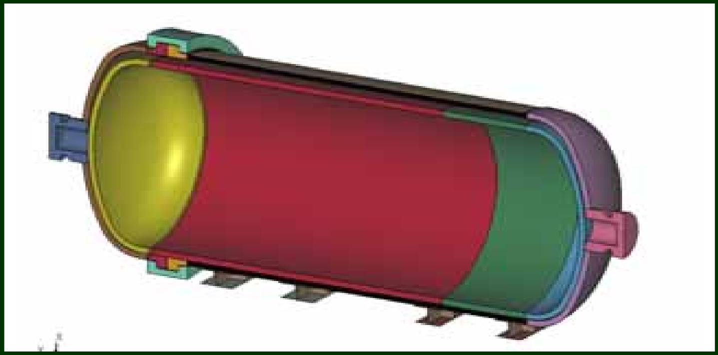
Model of Transportation Vessel (LS-DYNA)

5) Dynamic Analysis by AUTODYN-3D



6) Dynamic Analysis by LS-DYNA
(Behavior of Chamber)

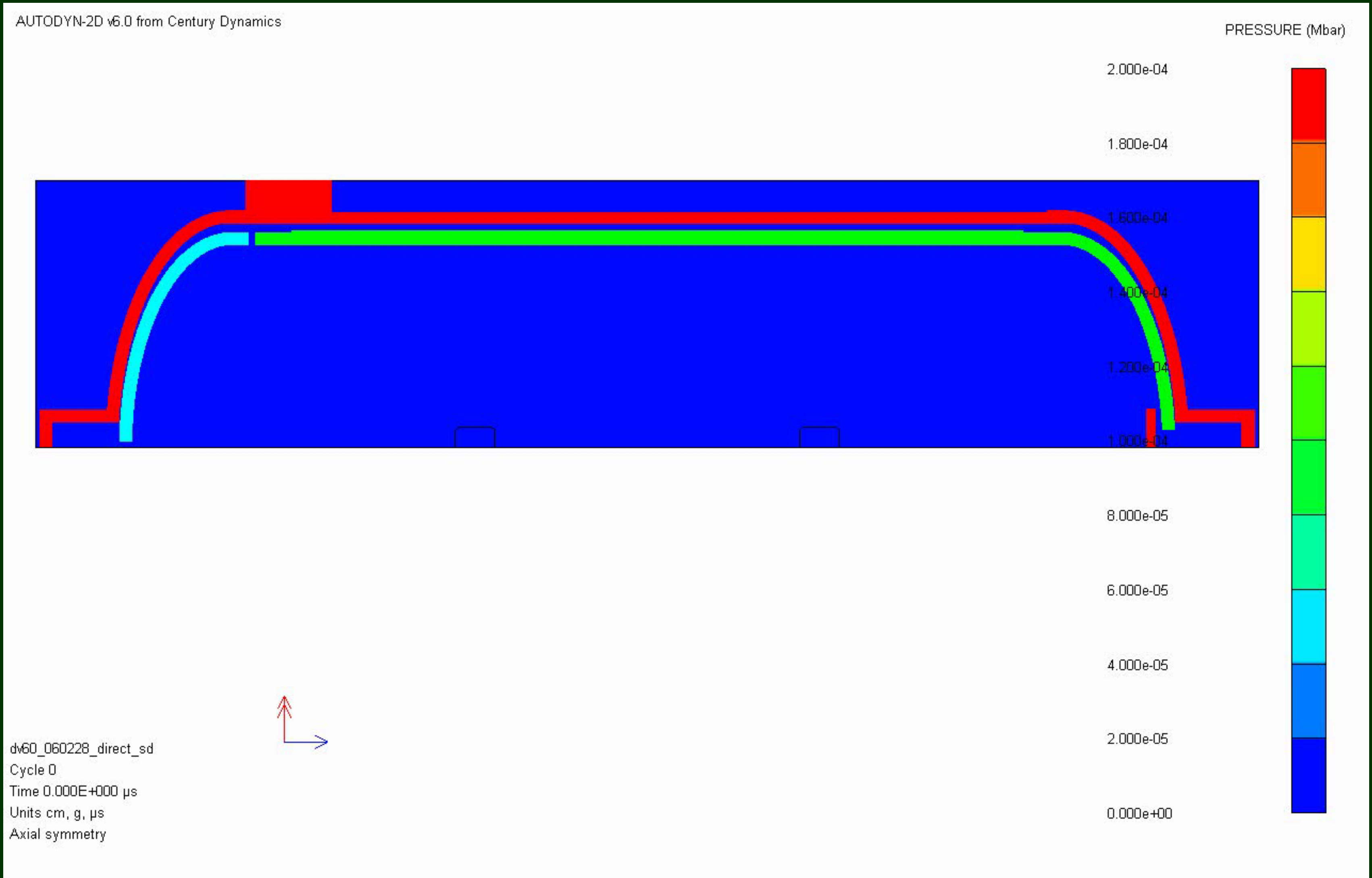




	DV 45	DV 60
Maximum TNTeq, Throughput	45 kg (2~3 sequential detonation) 8,000/year	60 kg (3~4 Simultaneous Multi Detonation) 12,000/year
Detonation	Sequential detonation	Simultaneous Multi Detonation

Example of Dynamic Analysis of DV 60

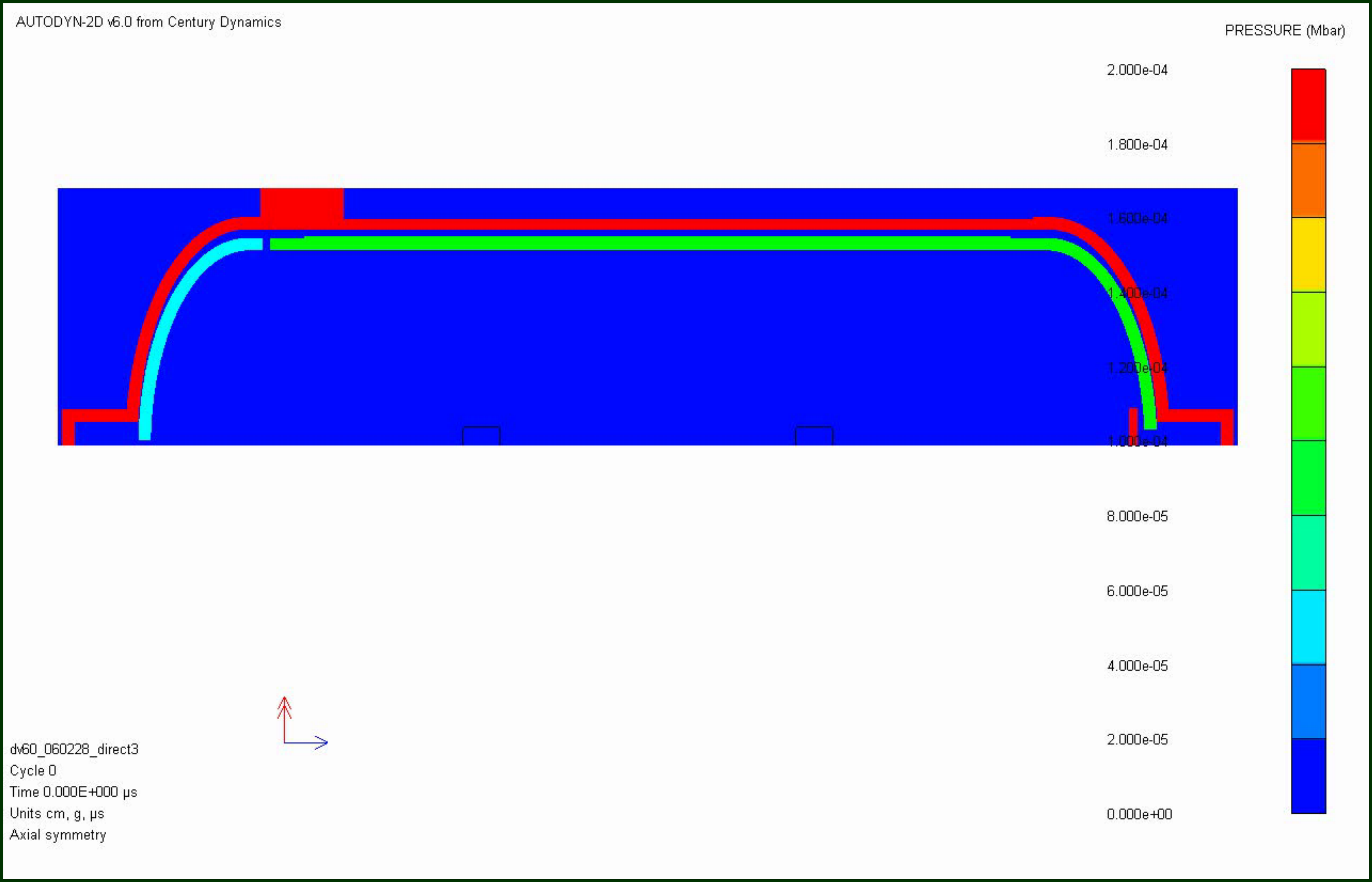
Results of AUTODYN



Gas Pressure Sequential detonation

Example of Dynamic Analysis of DV 60

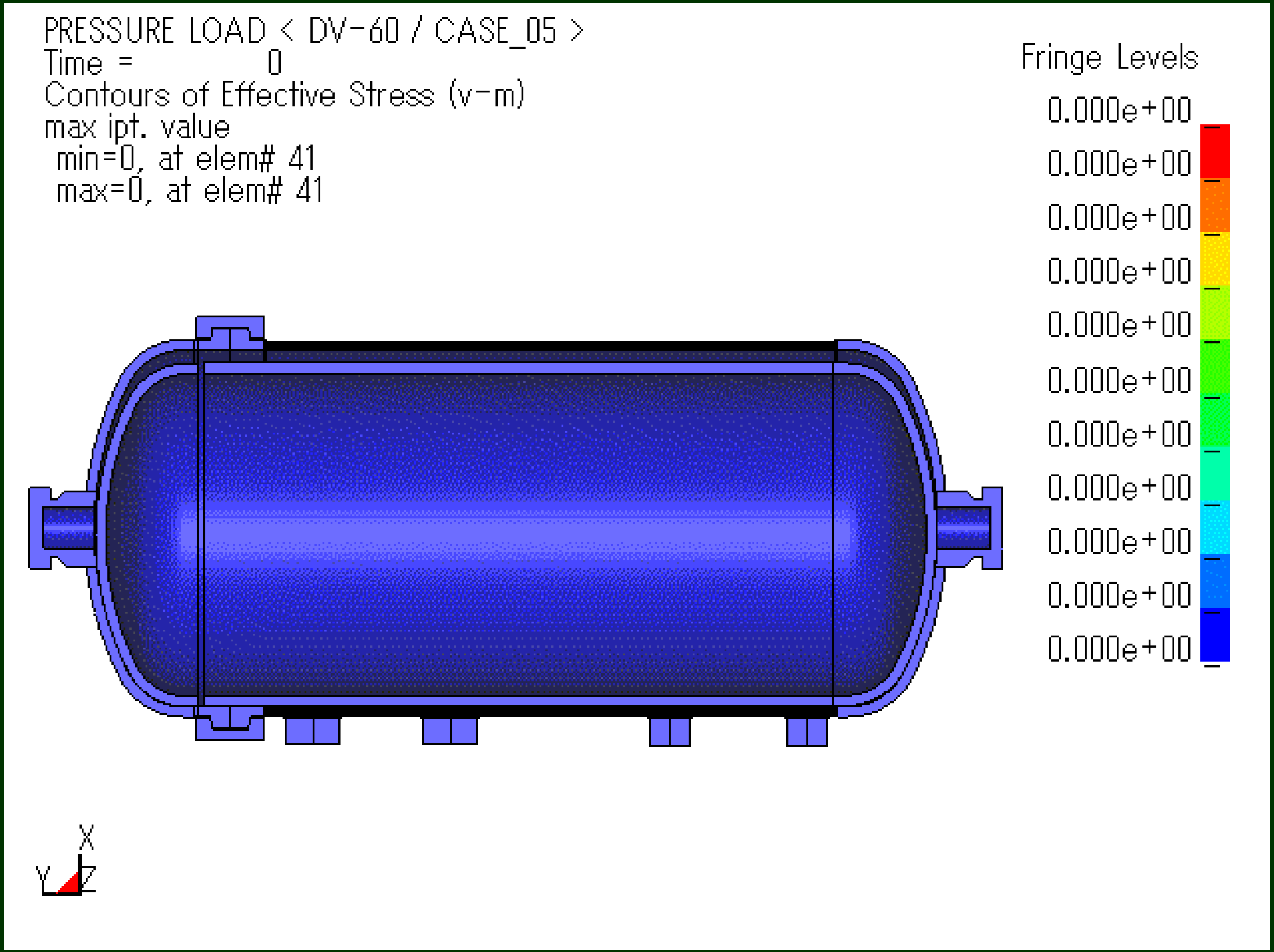
Results of AUTODYN



Gas Pressure Simultaneous multi detonation

Example of Dynamic Analysis of DV 60

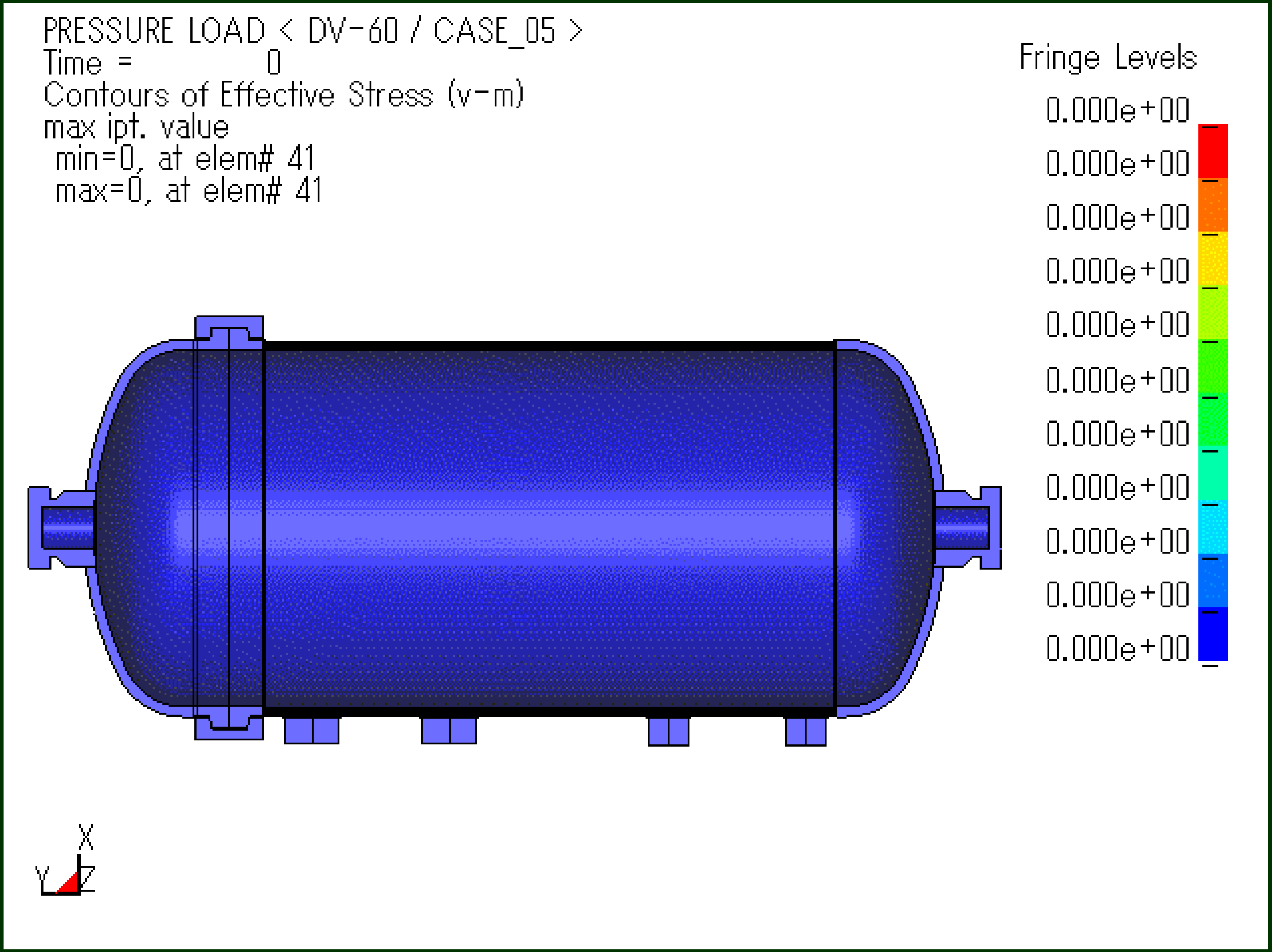
Results of LS-DYNA



Equivalent stress of inner chamber

Example of Dynamic Analysis of DV 60

Results of LS-DYNA



Equivalent stress of outer chamber

Expected Life of the Chamber

1) Inner Chamber

Outer View of Inner Chamber (test piece removed)

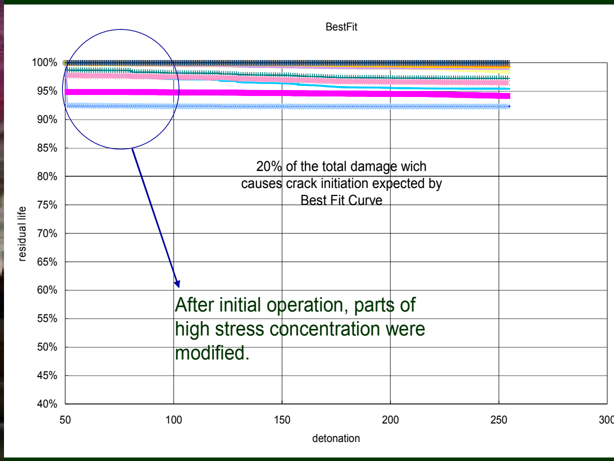
Inner Wall

Mark by Fragments

(1) After over 250 shots, no big damages to be found.

(2) Expected to be used for 1,000 ~ 2,000 shots, depending upon the conditions.

2) Outer Chamber



Cumulative fatigue damage of each point of interest for 250 shots

(1) 3~5% of the time to the crack initiation is consumed in 250 shots.

(2) 5,000~8,000 shots can be expected before crack initiation.

(3) Cracks can easily be removed when they are found

Leak-Before-Burst mode of failure

DAVINCH is designed under the failure mode of L-B-B Not under brittle fracture nor plastic deformation

American Society of Mechanical Engineers (ASME) is preparing a new design code on Impulsively Loaded Vessel

burst

1880

ASME

Power Boiler &
Pressure Vessel
Code

1914

ASME

SEC VIII

div 3
code case

2007

before

burst

Real Operation of DV 60 at Kanda

Movie to be shown at the Conference

Summery：Now you know what is controlled detonation.

- Detonation Timing
- Type and Amount of Donor Charge
- Size and Speed of Fragments
- Duration of Time of Fire-ball
- Maintenance Schedule by DESTINY
- Life of the Chamber
- Mode of Failure

DA VINCH™ Code

Controlled Detonation

- Thank you very much for your kind attention.

Any question?

Acknowledgement

The authors wish to express many thanks to

1) Mr. K. Kinoshita, Operation bureau, The Japan Defense Agency

2) Dr. S. Fujiwara, National Institute of Advanced Industrial Science and Technology, Japan

3) Professor M. Lefebvre, Mr. B. Vanclooster, Royal Military Academy, Belgium

4) Dr. Robert Nickell, Chair of the Special Working Group for Impulsively Loaded Vessel, American Society of Mechanical Engineers.

Actual Application of 2005 U.S. Army Regulation on Chemical Agents to DA VINCH

Ryusuke Kitamura and Shigeo Tachibana

Kobe Steel, Ltd.

Outline of presentation

- Introduction
  - What is DA VINCH ?
  - Kanda Weapon Destruction Facility
- Detonation test to confirm the compliance of DA VINCH to revised U.S. regulations (AELs)

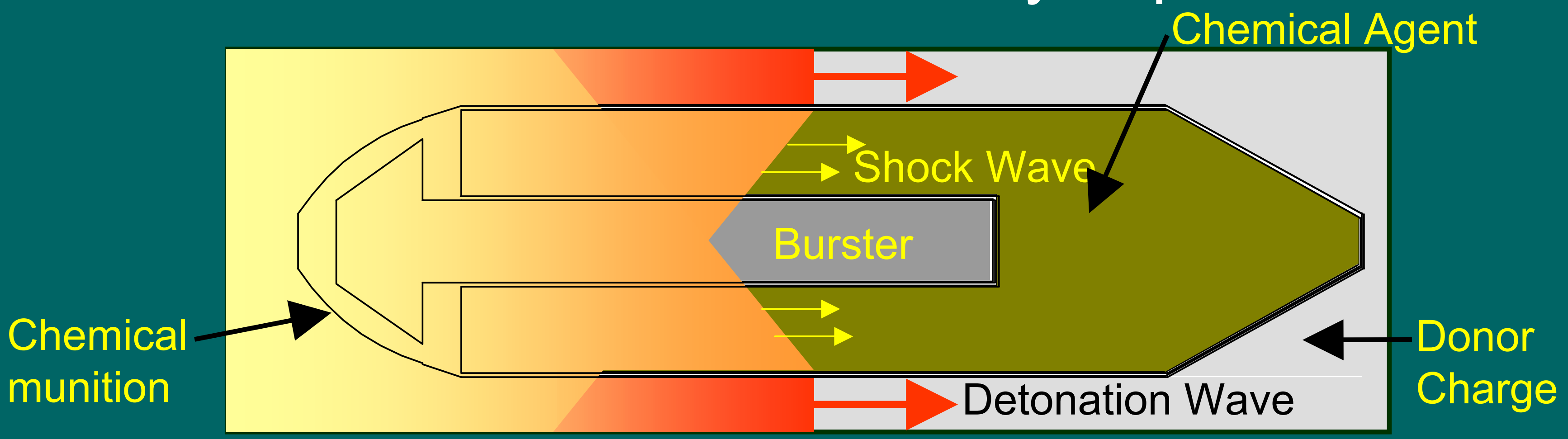
What is DA VINCH ?

- DA VINCH™
  = Detonation of Ammunition in Vacuum Integrated Chamber
- Controlled detonation system developed for chemical weapons destruction
- Destroyed more than 600 chemical bombs in Japan

DA VINCH DV60 detonation chamber in Kanda, Japan

Destruction of chemical agent and energetic materials in the same time

Destruction Mechanism by Implosion



	Chemical Agent Destruction Mechanism
1st step	Instantaneous compression by shock wave, shock pressure of 10 GPa and temperature of 3000K, and instantaneous quench after shock wave has gone: no time for dioxins formation
2nd step	High speed mixing and reaction of CA with detonation gas at high pressure and high temperature
3rd step	Thermal decomposition by the long-lasting fire ball of 2000 degree C for 0.5 sec.

Emulsion Explosive as donor charge

(1) Easier handling,

(2) Safer operation,

(3) Easier composition control,

(4) Manufacturing on site, no storage of explosive necessary.

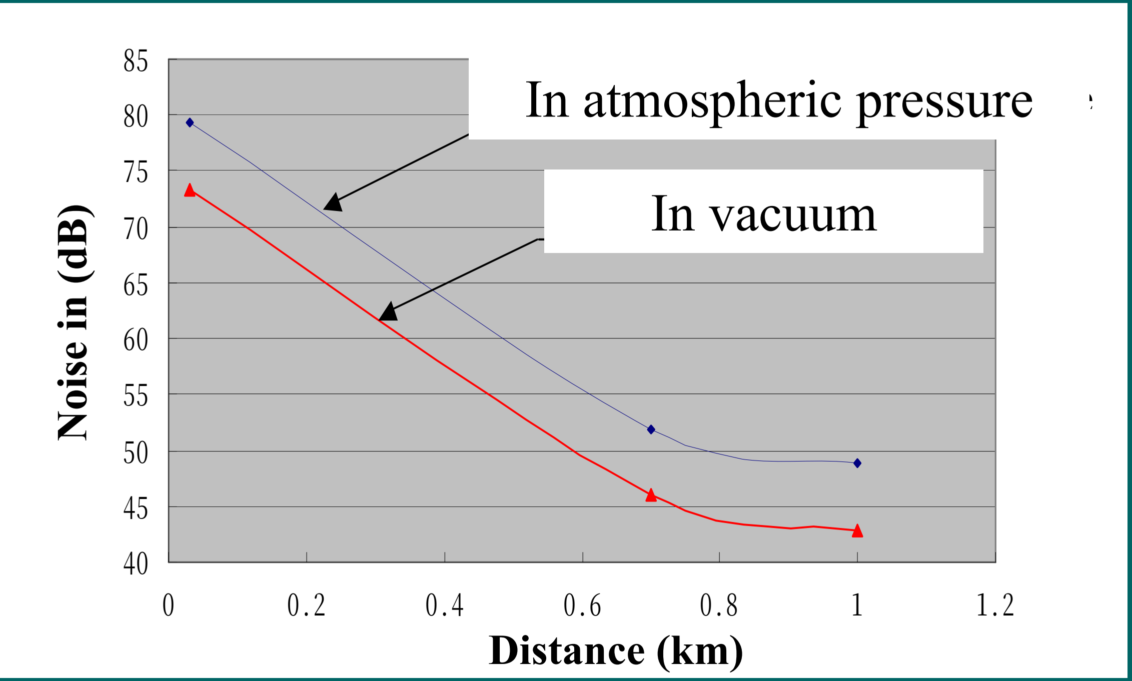



Detonation in vacuum with minimum oxygen supply

(1) Reduction of impulsive load

(2) Reduction of vibration and explosion sound

(3) Keeping the internal pressure negative within 1 minute after detonation.



Double walled structure with removable inner chamber

Inner chamber

Sacrificial chamber against fragments

Outer chamber

High-pressure vessel against impulsive pressure

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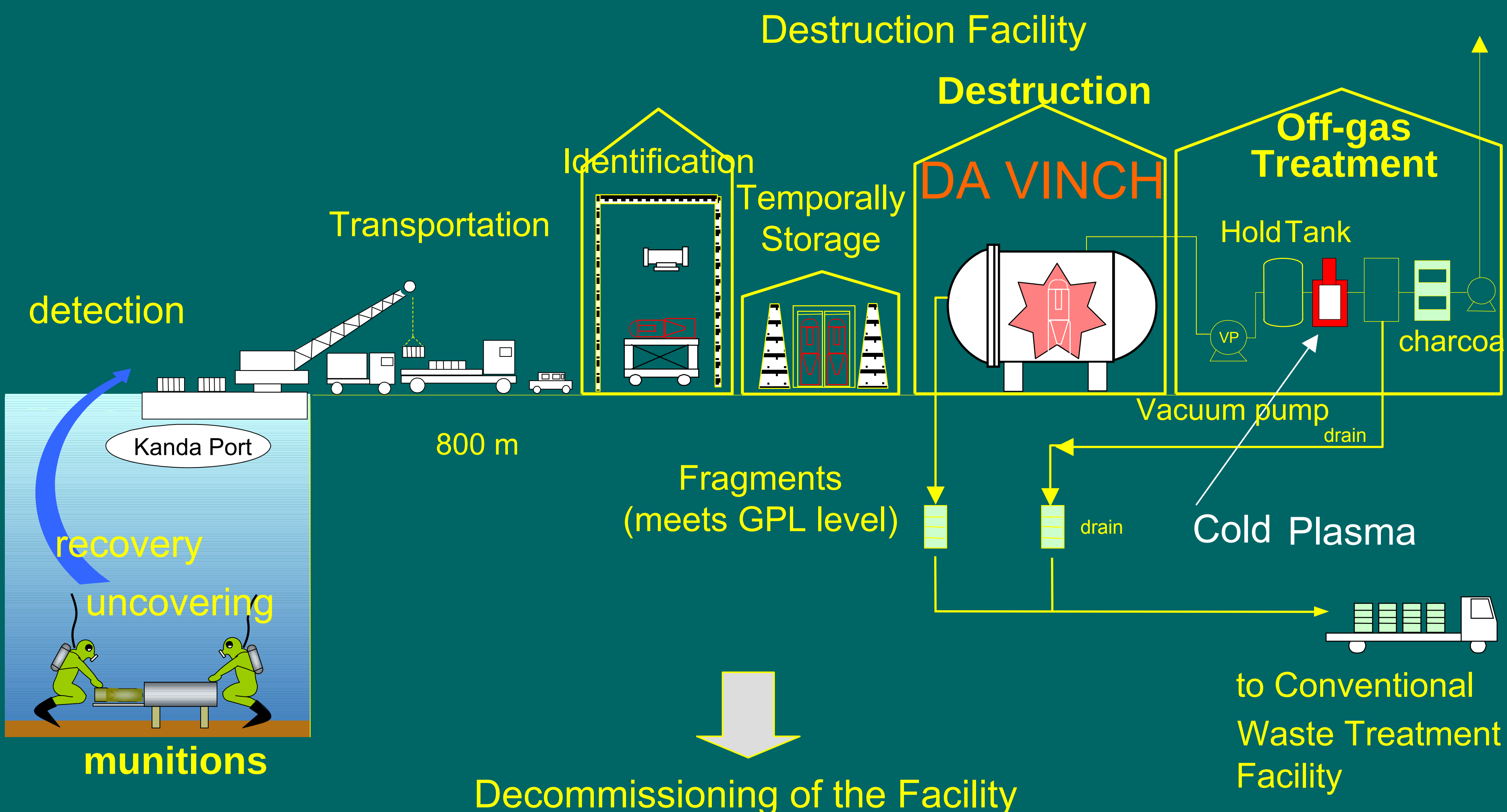
Kanda Weapon Destruction Facility (KWDF)

- Chemical bombs from WW2 on the sea bed in Kanda Port
- Detection, uncovering, recovery, transportation and destruction
- Destruction by DA VINCH
  - Phase 1: 2004
  - Phase 2: 2005
    total of 100 50-kg yellow bombs and 500 15-kg red bombs
  - Phase 3: 740 bombs expected, 2006 (just started)

Outline of Kanda Project



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Being in operation now

- Kanda Phase 3 operation has been started on April 25, 2006
- About 740 bombs are to be destroyed
- Still more bombs are expected to exist in the sea

Project ID. No.	April 24 Mon	25 Tue	26 Wed	27 Thu	28 Fri	29 Sat	30 Sun	Project ID. No.
KK-001								KK-001
KK-002								KK-002
KK-003								KK-003
KK-004								KK-004
KK-005								KK-005
KK-006								KK-006
KK-007								KK-007
KK-013								KK-013
KK-008								KK-008
KK-009								KK-009
KK-014								KK-014
KK-015								KK-015
KK-010								KK-010
KK-016								KK-016
KK-018								KK-018
KK-011								KK-011
KK-012								KK-012
KK-017								KK-017
KK-019								KK-019
KK-020								KK-020
KK-021								KK-021

Throughput of DA VINCH

Example for U.S. chemical munitions
10 hours/day, 1.5 hour/shot, 6 shot/day
with manual munitions handling

			DV100			DV60		
			munitions per shot	shot per day	munitions per day	munitions per shot	shot per day	munitions per day
4.2-in mortar	M1	HD	9	6	54	5	6	30
75mm projectile	M64	HD	8	6	48	5	6	30
5-in projectile	MK VI	HD	5	6	30	3	6	18
5-in projectile	MK 54	GB	3	6	18	2	6	12
155mm projectile	MK II	CG	3	6	18	1	6	6
8-in projectile	T-174	VX	1	6	6	1	6	6
100-lb bomb	M47	HD	1	6	6	1	6	6
115-lb bomb	M70	L	1	6	6	1	6	6
Bomblet	M139	GB	20	6	120	12	6	72
105mm projectile	M60	HD	7	6	42	4	6	24

Throughput of DA VINCH (continued)

Example for U.S. chemical munitions
10 hours/day, 1.25 hour/shot, 8 shot/day
with automated munitions handling

			DV100			DV60		
			munitions per shot	shot per day	munitions per day	munitions per shot	shot per day	munitions per day
4.2-in mortar	M1	HD	9	8	72	5	8	40
75mm projectile	M64	HD	8	8	64	5	8	40
5-in projectile	MK VI	HD	5	8	40	3	8	24
5-in projectile	MK 54	GB	3	8	24	2	8	16
155mm projectile	MK II	CG	3	8	24	1	8	8
8-in projectile	T-174	VX	1	8	8	1	8	8
100-lb bomb	M47	HD	1	8	8	1	8	8
115-lb bomb	M70	L	1	8	8	1	8	8
Bomblet	M139	GB	20	8	160	12	8	96
105mm projectile	M60	HD	7	8	56	4	8	32

Detonation tests to demonstrate compliance of DA VINCH to revised U.S. regulation (AELs)

Background

- Revised AELs (2005)
- Wastes from destruction facilities can be shipped off site when confirmed the agent level in the air is lower than GPL by head space monitoring

Current and revised chemical warfare agent AELs*
(in milligrams per cubic meter of air)

Agent type	AEL Information	AEL type			
		General population limit (GPL)	Worker population limit (WPL)	Short-term exposure limit (STEL)	Immediately dangerous to life or health (IDLH)
GA, GB	*Revised limit (current limit)*	0.000001 (0.000003)	0.00003 (0.0001)	0.0001 (none)	0.1 (0.2)
	Averaging time	24 hours	8 hours	15 minutes	≤30 minutes
VX	*Revised limit (current limit)*	0.0000006 (0.000003)	0.000001 (0.00001)	0.00001 (none)	0.003 (0.02)
	Averaging time	24 hours	8 hours	15 minutes	≤30 minutes
HD	*Revised limit (current limit)*	0.00002 (0.0001)	0.0004 (0.003)	0.003 (none)	0.7 (none)
	Averaging time	12 hours	8 hours	≤15 minutes	≤30 minutes

**The Centers for Disease Control and Prevention is responsible for setting airborne exposure limits (AELs). For the current AELs, see FR 53, No. 50, pp. 8504-7 (March 15, 1988). For the revised nerve agent AELs, see FR 68, No. 196, pp. 58348- 51 (October 9, 2003); for the revised mustard agent AELs, see FR 69 No. 85, pp, 24164-8 (May 3, 2004).*

Table from:
http://www.cma.army.mil/publications.aspx?criteria=mission&value=CMA

Objectives

1.To demonstrate;

- Solid wastes (fragments and dust) from DA VINCH can be shipped off site without further treatment in compliant with revised U.S regulation: head space monitoring (in DA VINCH chamber)< GPL

2. In order to achieve 1.(above);

- maximum DRE, optimum HE/CA ratio
- effectiveness of cleansing shot (bulk explosive)

by using simulated 50kg yellow bombs filled with surrogates.

Objectives (continued)

3. Also to demonstrate;

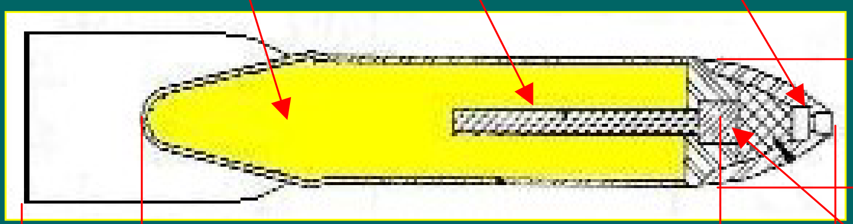
- destruction of heel (degradation product of CA)
- reduction of Cl in off gas by adding Cl scavenger (CaO_2)

Procedures

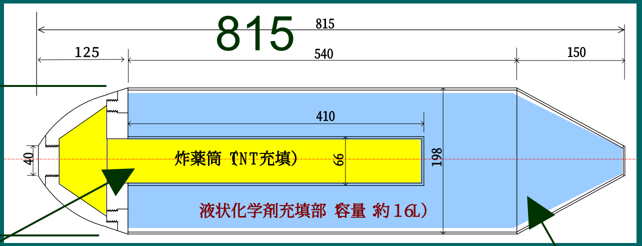
(1) Simulated 50kg Yellow Bomb

Actual 50kg yellow bomb

Chemical agent Mustard, Lewisite



simulated 50kg yellow bomb



Empty weight: 23kg

(2) Surrogates

Yellow agent = HD + L (1:1 mixture)

1) Characteristics to simulate

	Property to be simulated	Point of interest	Selection
Chemical agents	toxicity	chemical / toxic properties (molecular structure etc.)	
	DRE	chemical bond, (Molecular structure)	Double bond, triple bond
	Monitoring and analytical property	physical properties (volatility etc.)	
	State of degradation	Physical properties (viscosity etc.) composition	Simulated heel

H-L Heel in 50kg Yellow Bombs

Heel found in 50kgYellow bombs in Kussharo Project (2000) while discarding yellow agent from bombs

- Very viscous
- Difficult to destroy by neutralization or incineration

(2) Surrogates

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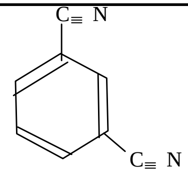
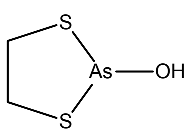
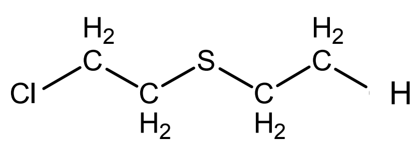
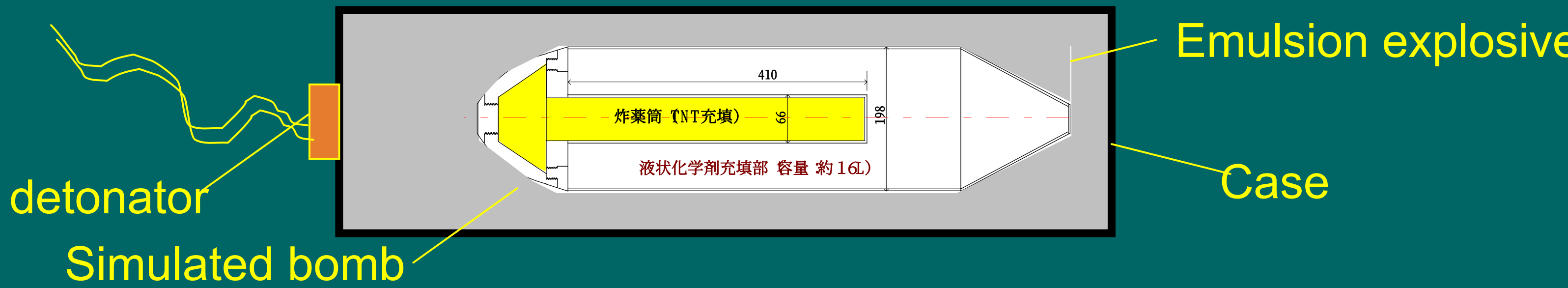
3)Selected surrogates

Selected surrogates	Chemical structure	Reason of selection	quantity
Oleic acid	H3C-(CH2)7-CH2=CH2-(CH2)7-COOH	Double bond (Lewisite)	4kg
Dicyanoben-zene		Triple bond; more stable than double bond	4kg
Octanol	H3C-(CH2)6-CH2-OH	Solvent for dispersing dicyanobenzene	4kg
Simulated heel	 + Fe2O3	Similar properties to actual heel (Synthesized and compounded according to analytical results of Kussharo heel)	2kg
CEES (Chloroethyl ethyl sulfide)		To simulate mustard Indicator for destruction of heel	0.1kg

Simulated heel

(3) Donor charge setting and detonation



Simulated bomb and emulsion explosive in case*

*Case made of aluminum for added fireball effect

Simulated bomb with donor charge hung in DAVINCH chamber

Results

(1) Agent concentration in gas

		Oleic acid (double bond) mg/m^{3}N	Dicyanobenzene (triple bond) mg/m^{3}N	CEES mg/m^{3}N
Aug.26	Kii-01	<0.08	0.013	<0.1
Aug.29	Kii-02	<0.08	0.02	<0.1
Aug.30	After cleansing shot	<0.08	<0.005	<0.02
Aug.31	After replacing gas and sealed for one night	-	-	**<0.00002***
Sept.2	Kii-03	<0.08	<0.005	<0.1

* 0.00002 mg/m^{3}N: revised GPL for HD

Solid wastes can be shipped off site

Results

(2) DRE

date	bomb	Conditions			DRE of surrogates					
					for CA remaining in off gas			For all remaining CA (in off gas, fragments, dust and on wall surface)		
		Surro-gates kg	NEQ TNTeq. kg	HE/CA ratio	Oleic acid %	Dicyano-benzene %	CEES %	Oleic acid %	Dicyano-benzene %	CEES %
Aug. 26	Kii-01	14.65	22.93	1.57	>99.9999	99.9999	>99.997	99.998	99.950	>99.992
Aug. 29	Kii-02	14.70	32.79	2.23	>99.9999	99.9999	>99.997	99.996	99.978	>99.985
Aug. 30	Cleans-ing shot	0.10	11.33	-	>99.9999	>99.9999	>99.999	>99.999	>99.999	>99.995
Sept. 2	Kii-03	14.1	17.90	1.27	>99.9999	99.9999	>99.997	99.990	99.886	>99.991

Results

(2) DRE (continued)

DRE

1) 99.9999 % for agent remaining in off gas
(same evaluation method as incineration)

*Lower DRE of CEES were due to small initial quantity.
Analytical results of remaining CEES in OFF gas were ND.

2) 99.99 % for all remaining agent

Effect of HE/CA ratio on DRE

No significant difference was observed in the range of HE/CA ratio in these tests, with DRE very high in all cases.

Effect of Cleansing shot

DRE improved by cleansing shot with no remaining agents detected after cleansing shot.

Results

(3) Cleansing shot

Inside chamber after detonation of bomb and before cleansing shot

Inside chamber after cleansing shot

Amount of dust was reduced by cleansing shot

Results

(4) Destruction of heel

	Observation	DRE of CEES mixed in heel
Kii-01	No heel splash found visibly on surface of chamber. CEES was not detected by analysis of wipe sample of surface.	> 99.992 %
Kii-02		> 99.985 %
Cleansing shot		> 99.995 %
Kii-03		> 99.991 %

Heel was successfully destructed.

CEES, the indicator, was destructed to the level below detection limit.

Results

(5) Effect of Cl scavenger

	HCL ppm (volume)	
50kg Yellow bomb detonation tests*	<0.5	Below detection limit
Yellow bombs (actual destruction operation at Kanda site)	6-50	
Red bombs (actual destruction operation at Kanda site)	1-4	
Detection limit	0.5	

*CaO_2 was added as Cl scavenger ($CaO_2 + Cl_2 \rightarrow CaCl_2 + O_2$)

Cl scavenger was effective.

Summary

(1) Compliance with revised U.S. regulation was confirmed

Fragments and dust can be shipped off site

chemical agent level in head space (in DA VINCH chamber) < 0.00002 mg/m^{3}N (GPL for HD)

(2) High DRE was confirmed

1) for agents remaining in gas
(the same evaluation method as hot detonation and incineration)

DRE：99.9999%

2) for all remaining agents

(gas + fragments + dust+ wall surface)

DRE：99.99%

Summary (continued)

(3) Effectiveness of cleansing shot was confirmed

Cleansing shot after detonation of simulated bomb destructed remaining agents and reduced dust in the chamber

(4) Destruction of heel (degradation products) was confirmed

Observation results:

heel did not remained after detonation

CEES mixed in simulated heel as indicator: DRE>99.985%

(5) Reduction of Cl in off gas was confirmed

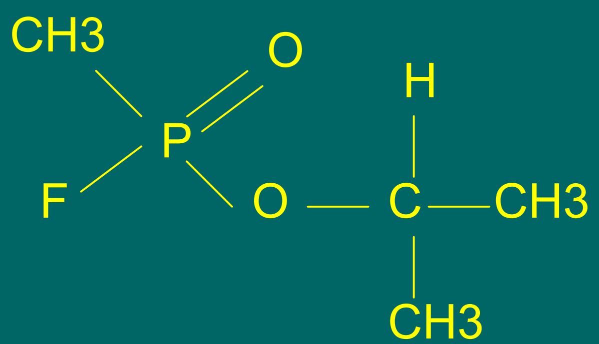
By adding chlorine trap, HCl was reduced to the level below detection limit (<0.5ppm(vol.))

Latest update – nerve agent destruction test

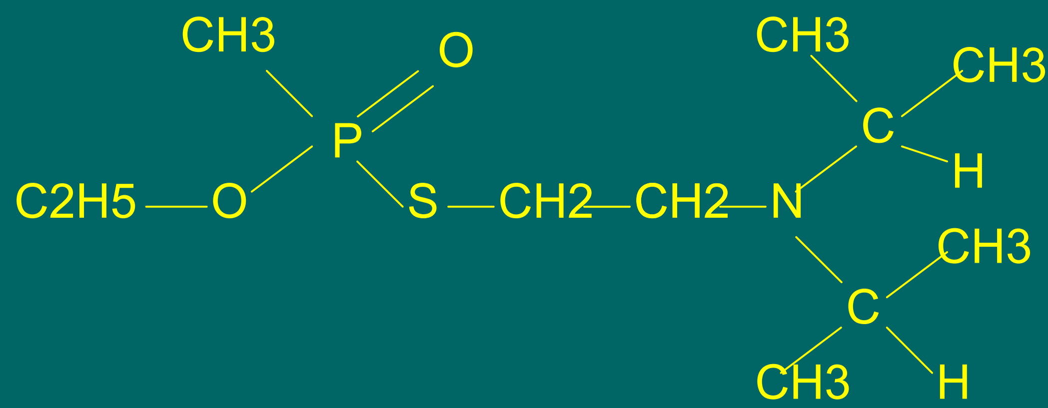
- Preliminary miniature destruction test (April 19, 2006)
- Target: GB, VX
  residual agent concentration in off-gas < STEL (0.0001mg/m3 for GB, 0.00001 mg/m3 for VX)
- Surrogate: 6.56 g of DDVP (dichlorvos)*
  *DMMP (dimethyl methyl phosphonate) for further tests
- Surrogate was detonated with donor charge (40g of PETN)

Nerve agents / surrogates

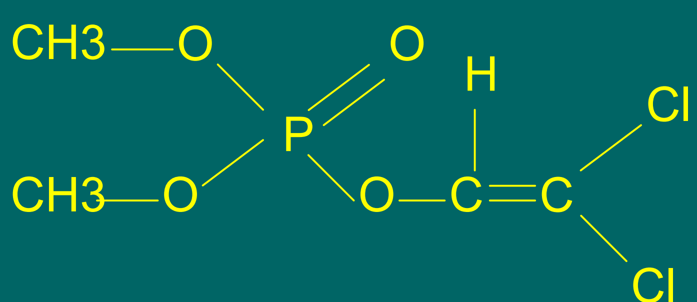
GB



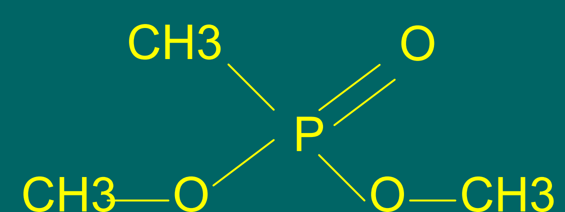
VX



DDVP (dichlorvos)



DMMP (for further tests)



Result

- Surrogate concentration in detonation off-gas
  < 0.1 micro gram/liter
  (determination limit)

  *gas volume was too small compared to the determination limit to achieve accurate analysis

- Further test is planned

Future plan

- We would like to continue on further tests to achieve STEL for off-gas, GPL for head space monitoring of fragments

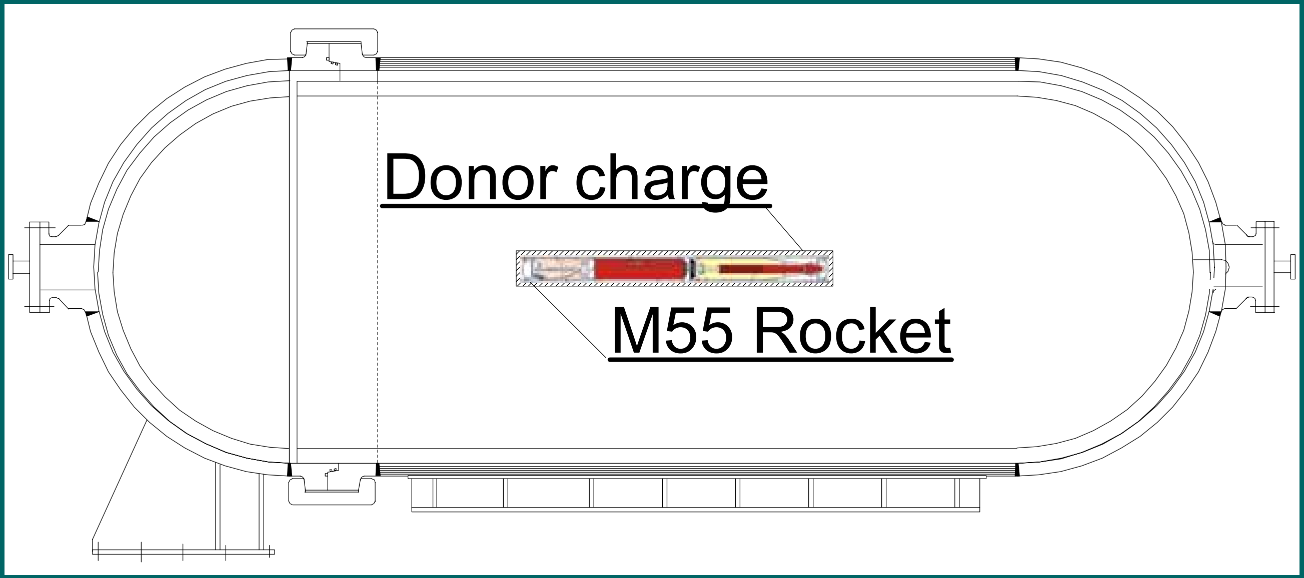


Image of destruction of M55 by DA VINCH

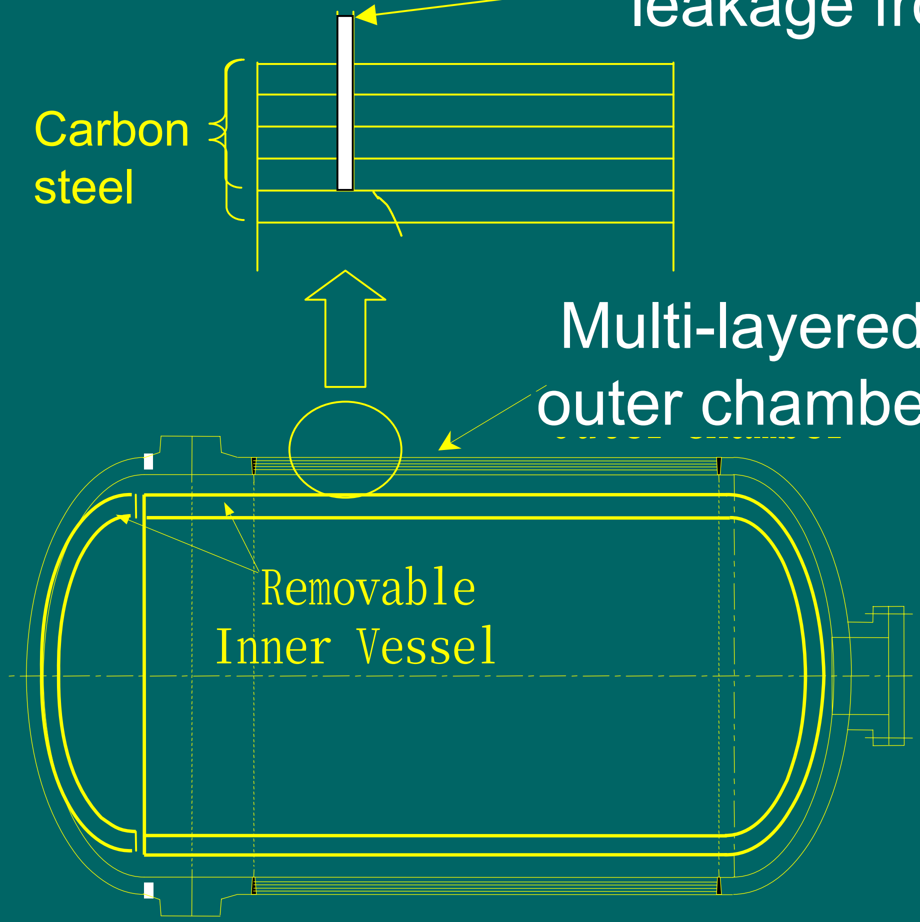
Thank you for your attention

Any questions ?

Appendix

Multi-layered Outer Chamber

Detection hole to monitor the leakage from the 1st layer



Multi-layered outer chamber

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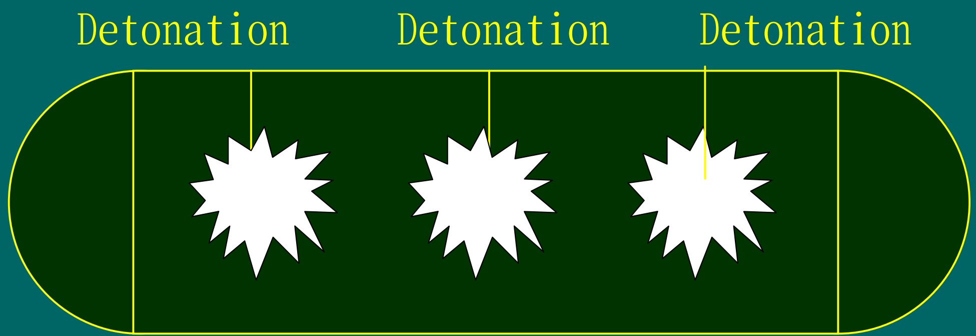
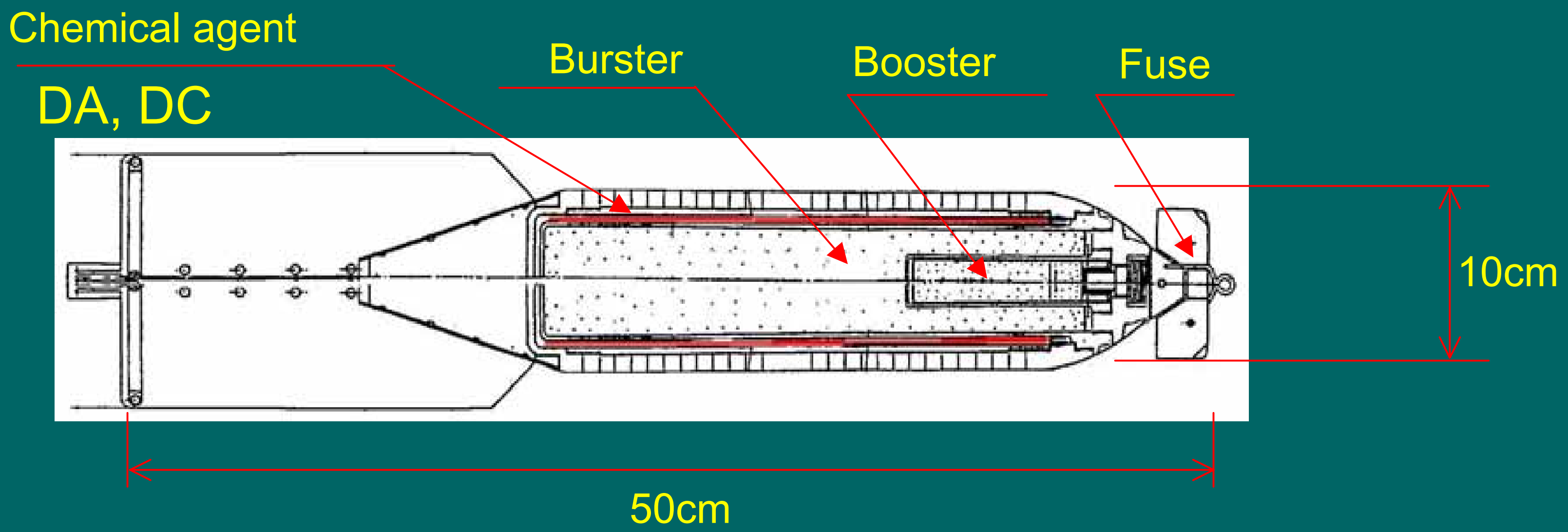
Multi Detonation



For higher throughput ⇨ No further development necessary,
To make the cylindrical part longer,
Welding on site due to transportation limit,

Assembly on site

Munitions destroyed at KWDF



15kg Red Bomb (HE:1.3kg , CA:368 g)

DA VINCH in operation

Destroying 15kg-red bombs

Surrogates

Properties of heel (degradation products)

Project	Container	Composition	Characteristics	Environment	Destruction method
Lake Kussharo	shell (bomb)	T-As: 30 to 40 T-S: 1 to 2 Cl: 10 to 17 Fe: 10 to 40 C: 10 to 20	Asphalt-like or gum-like highly viscous material	Freshwater, Container: Low corrosion	NaOH, polar solvent, oxidizing agent
Samukawa	Glass bottle	polymerized Lewisite	Stone-like hard material	Sealed in glass bottle	incineration
Kanda	shell (bomb)	Fe, As, C, Cl, O	Asphalt-like or gum-like highly viscous material	Sea water, Container: highly corroded	detonation
China	shell	Fe, As, C	Asphalt-like or gum-like highly viscous material	Soil Container: Low corrosion	detonation
Detonation test	Mock shell (bomb)	Fe, As, C, Cl, O	Asphalt-like or gum-like highly viscous material		detonation

(4)Sampling and analysis

	Components	Sampling	Analysis	Detamina-tion limit
Gas	Oleic acid, CEES, Dicyanobenzene	Gas inside DAVINCH chamber was directly sampled	GC-MS	0.1mg/m^3
	O_2, N_2, H_2, CO		GC-TCD	0.01～2%
	HCl, NOx, etc.		Detector tube	0.2～4ppm
Wall sur-face	Oleic acid, Dicyanobenzene, CEES	•Wipe sampling by cloth dipped in acetone •5 Square areas of 15cm x 15cm each on 4 segments (door, back and both sides) of inner surface of chamber (total 20 areas)	GC-MS	0.03～0.15mg/m^2
Solid residu es	Oleic acid, CEES, Dicyanobenzene	Sample was taken from collected solid residues (all of solid residues were collected)	GC-MS	0.1～1mg/kg
	As		fluorescent X-ray	0.1mg/kg

Arsenic treatment and its behavior of the DA and DC destruction process through DA VINCH detonation

Tsuyoshi IMAKITA[1], Keiichi ISHIYAMA[2], Kiyoshi Asahina[2] and Yutaka Inada[2]

[1] Kobelco Research Institute,Inc.,

[2] KOBE STEEL, LTD.

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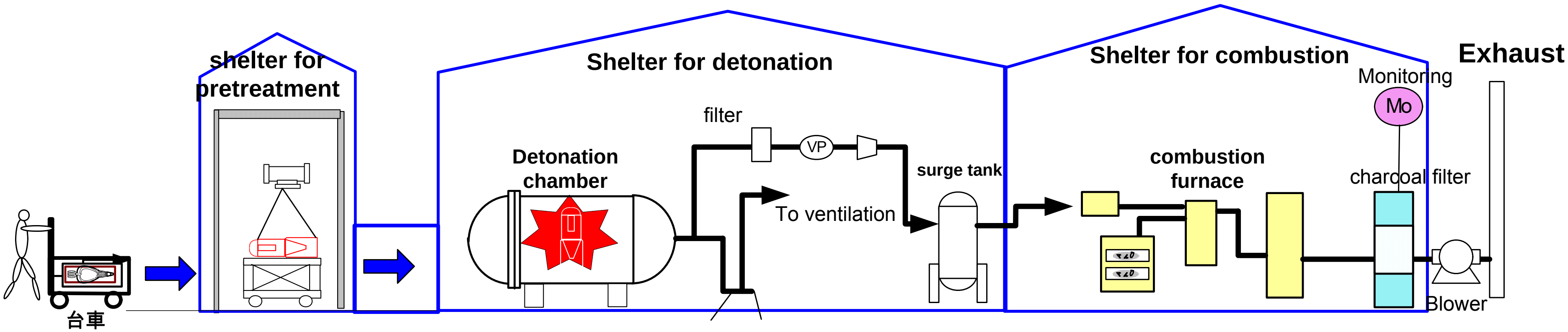
Outline

- Japanese old ammunitions in the Kanda port were destructed by the controlled detonation process named ‘DAVINCH*1’.
- Arsenic contained in the ammunitions was characterized from detonation to waste.
- It was found that arsenic was mostly remained in the detonation chamber and a few part was transferred to gas phase.

*1 **D**etonation of **a**mmunition in **v**acuum **in**tegrated **ch**amber system



Process diagram

Kanda Chemical Weapon Destruction Facility

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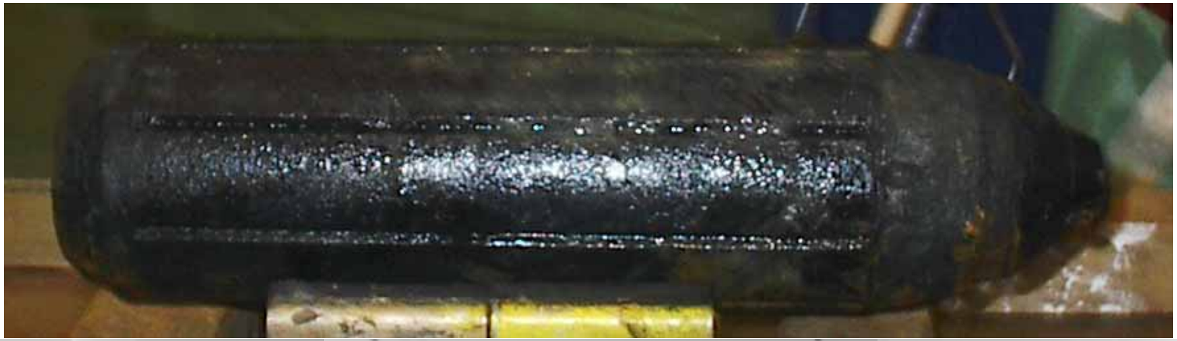
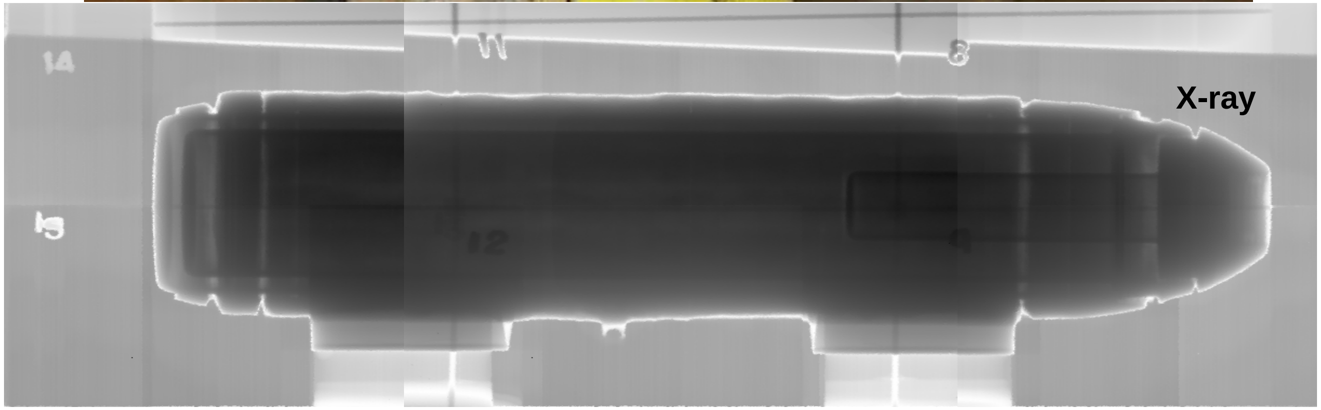
Objectives of demilitarization
Type: 15kg Red Bomb





Photos of typical red bomb

Chemical Agent	Arsenic calculated
DC 368g	As 108g

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Arsenic Deformation

<u>Arsenic containing CA</u>

DA(Clark I) : $(C_6H_5)_2AsCl$

DC(Clark II) : $(C_6H_5)_2AsCN$

L : $CHCl{=}CHAsCl_2$

Detonation

<u>Destruction compounds</u>

BDPAO : $(C_6H_5)_2AsOAs(C_6H_5)_2$

DPAA : $(C_6H_5)_2AsOOH$

Inorganic arsenic

- As(0) : metallic arsenic
- As(III) : eg. As_2O_3
- As(V) : eg. As_2O_5

Analysis of Arsenic and its related compounds for the demilitarization of red bomb

Analysis for Process control

Object of Sampling	Sampling Position	Target of Analysis	Method
Detonated gas in detonation chamber	Inside the Chamber	Residual DA, DC Decomposition compounds (BDPAO, DPAA)	GC-MS
		T-As in suspended dust	XRF
Dust on the fragments	Tray of fragment	Residual DA, DC Decomposition compounds (BDPAO, DPAA)	GC-MS
		T-As and Arsenic speciation	ICP-AES

Analysis of Arsenic and its related compounds for the demilitarization of red bomb

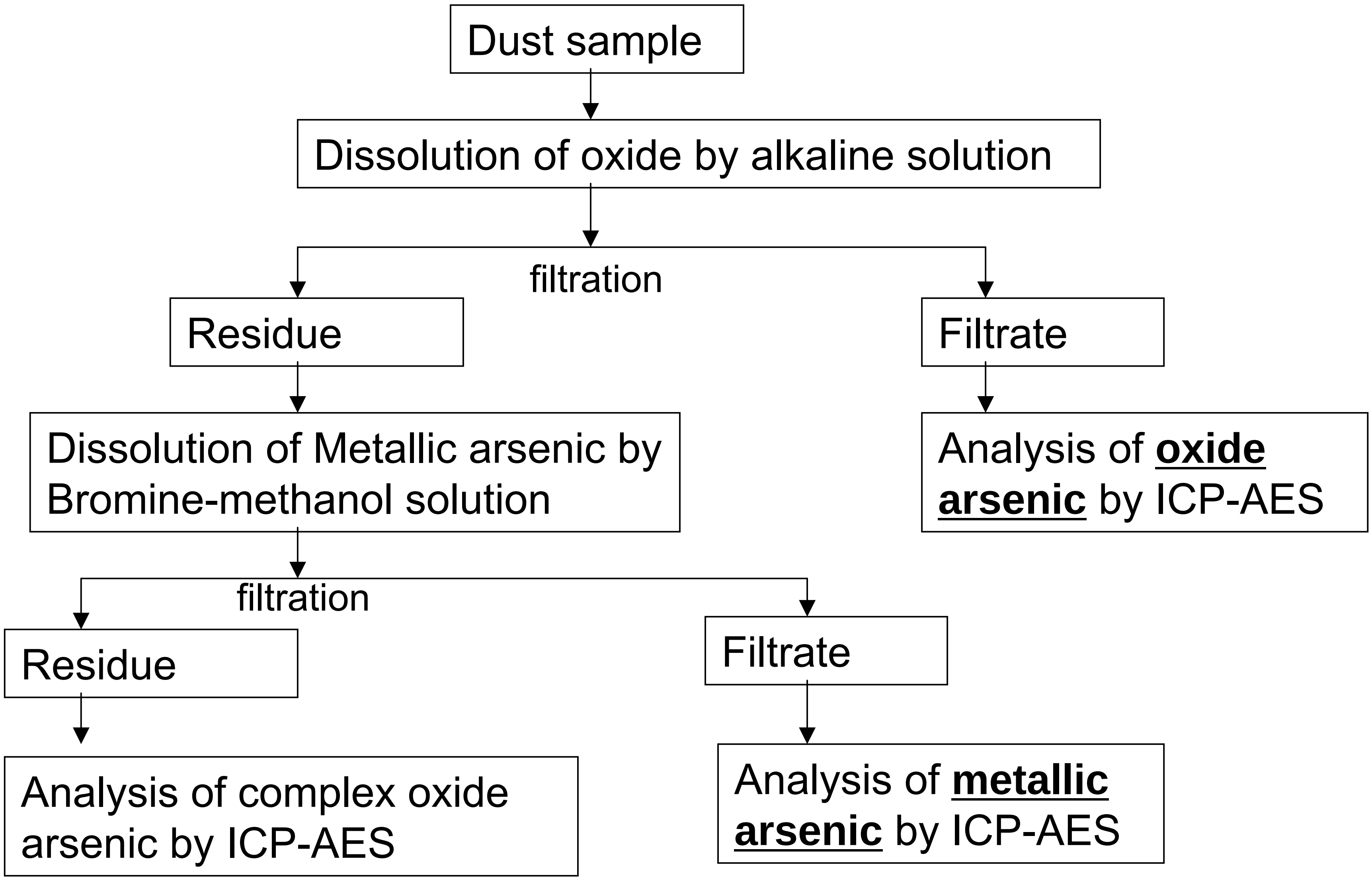
Environmental Protection and waste management Analysis

Object of Sampling	Sampling Position	Target of Analysis	Method
Emission from the facility(process gas and ventilation gas)	Stack(near the exit after gathering of ventilation and process gas)	T-As	ICP-AES or Flameless AAS
Liquid waste	Liquid waste tank	DPAA	GC-MS

Detection limits for Arsenic and its related compounds

Specimen	Target	Method	Detection limit
Chamber gas	DPAA	Solid sorbent extraction-GC-MS	0.05mg/m^3
Air	T.As	ICP-AES or Flameless AAS (Off-site analysis)	0.001mg/m^3
Liquid waste	DPAA	Solvent extraction-thiol-derivatization-GC-MS	0.01mg/L
Solid waste	DPAA	Solvent extraction-thiol-derivatization-GC-MS	0.1mg/kg

Arsenic Speciation Analysis of Dust sample



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Detonation process

Detonation Chamber

Inside of the chamber
after detonation

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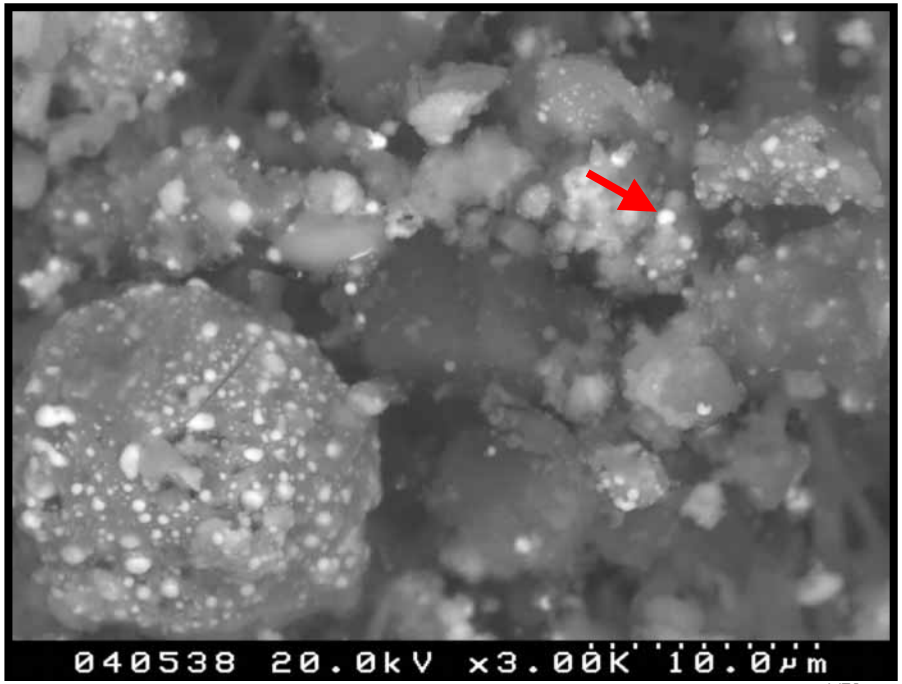
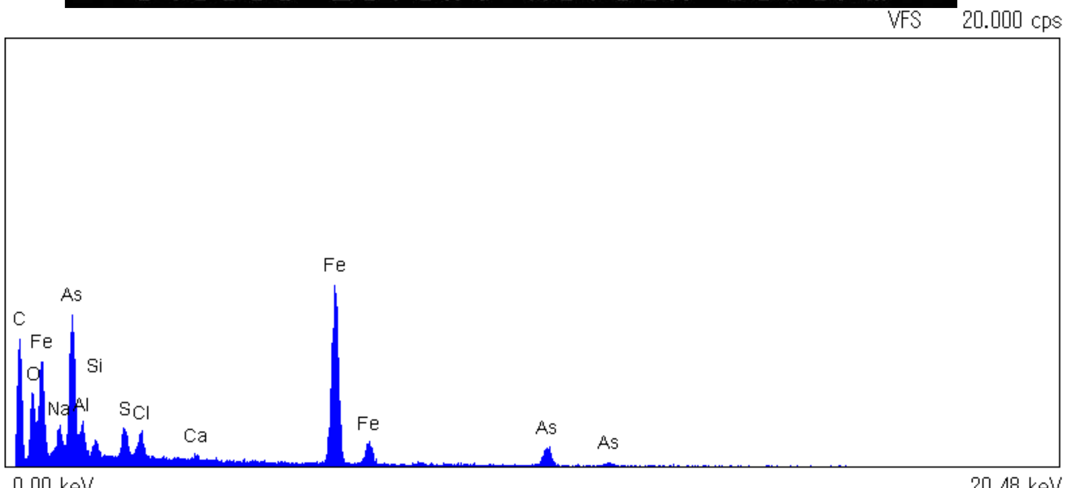
Collected dusts in detonated gas



Reflected electron image, Ｘ 3000



Intensity

Energy of X-ray

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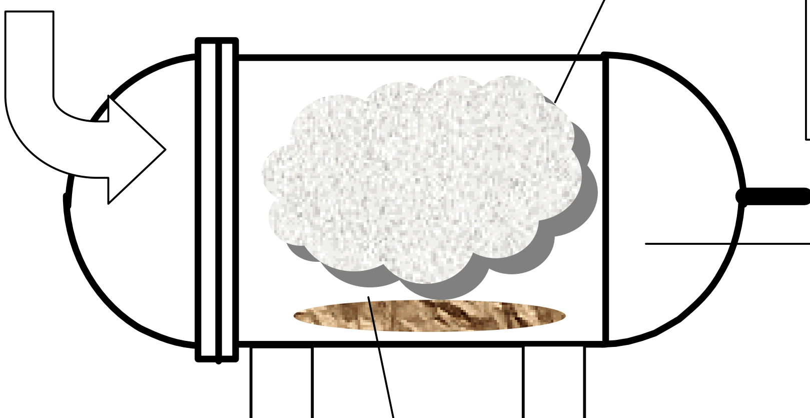
Typical Arsenic Distribution in Detonation Chamber

One Red bomb

As **<u>108g</u>**(DC:368g)



As in suspended dust
30~40mg/m^3
⇩
Total As: 0.28%(0.3g)
(Gas volume 9.25m^3)

Gaseous As(DPAA):$\leqq$0.05mg/m^3
⇨ Total gaseous As:$\leqq$0.0005g

As in fragment(5.9kg):0.32mg/g
As in residual dust(4.5kg):24mg/g
⇩
Total As: >99% (107.8g)

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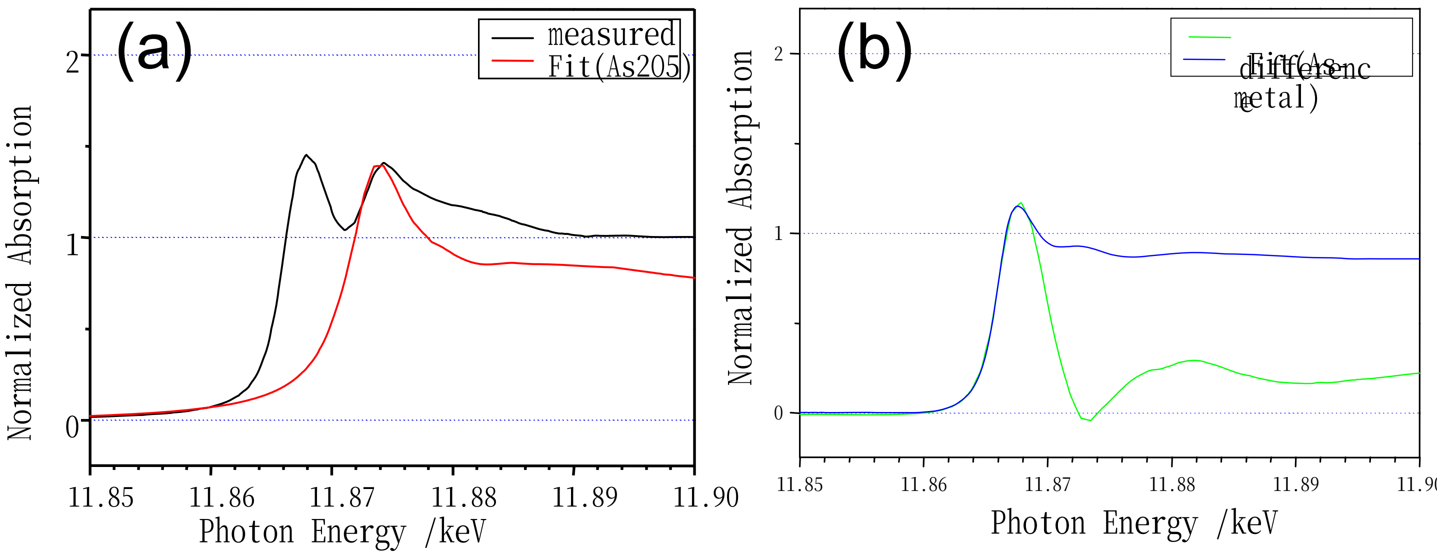
Typical analytical results of arsenic of dusts of detonated red bomb

Specimen	unit	Speciation analysis			T.As*2
		DPAA*1	Metallic As	As as Oxide	
Dusts on frag-ments of red ammunitions	Concn.(mg/g)	<0.0001	0.22	0.011	0.32
	Ratio(%)	<0.1	70	3	-
Dusts in the cmhamber	Concn.(mg/g)	0.1	21	2.4	24
	Ratio(%)	<0.1	88	10	-

*1 DPAA means summation of DA,DC,BDPAO and DPAA

*2 Alkali fusion dissolution-ICP-AES

Speciation of Arsenic by EXAFS



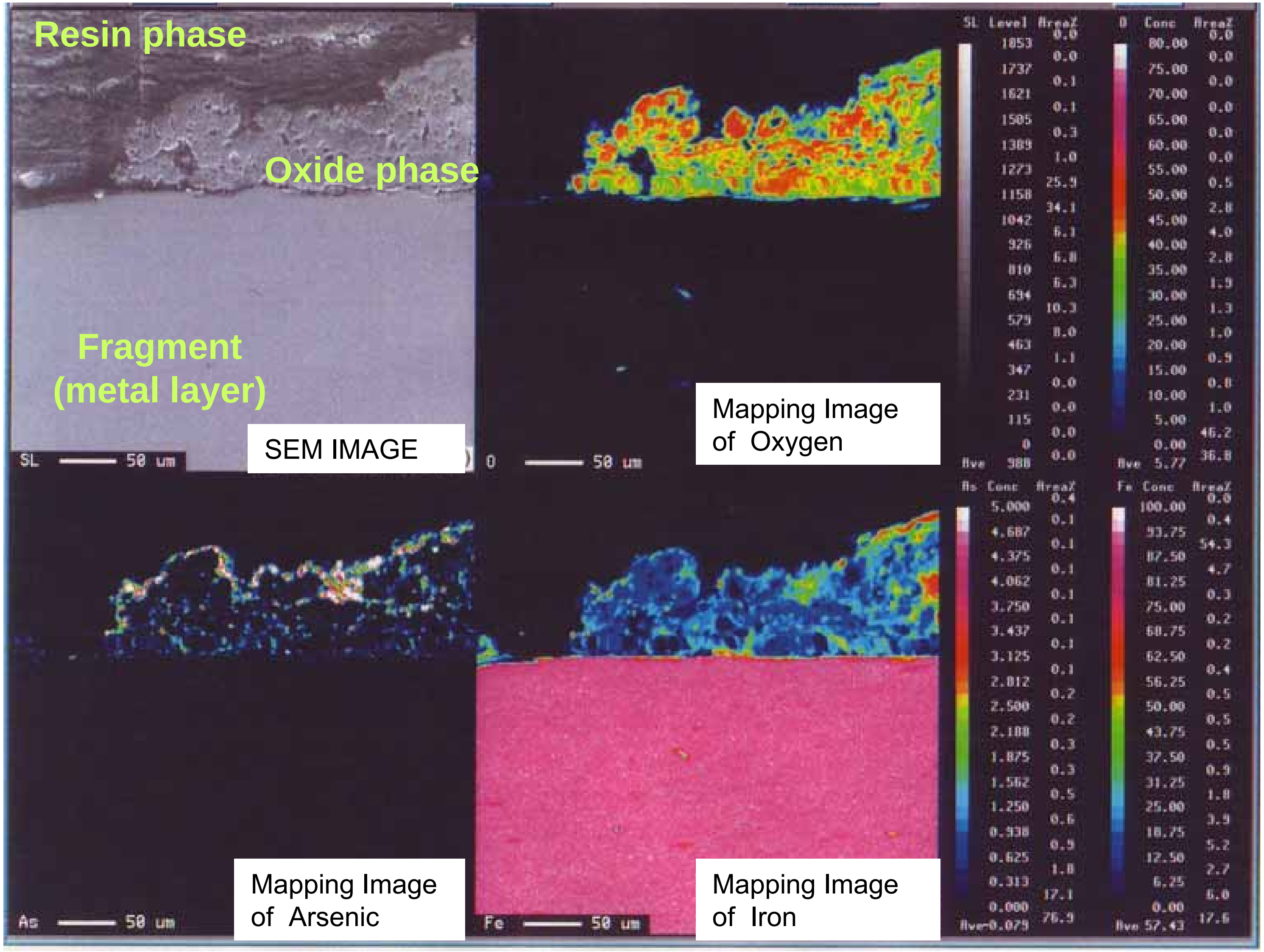
EXAFS spectra of arsenic Kα of the dusts on the fragments

(a) measured and As2O5 fitted spectra

(b) residual spectra and metallic As fitted spectra

Specimen	Ratio of Metallic As(%)	
	Chemical analysis	EXAFS
Dusts on fragments of red ammunitions	70 88	52

EPMA analysis of arsenic on fragment



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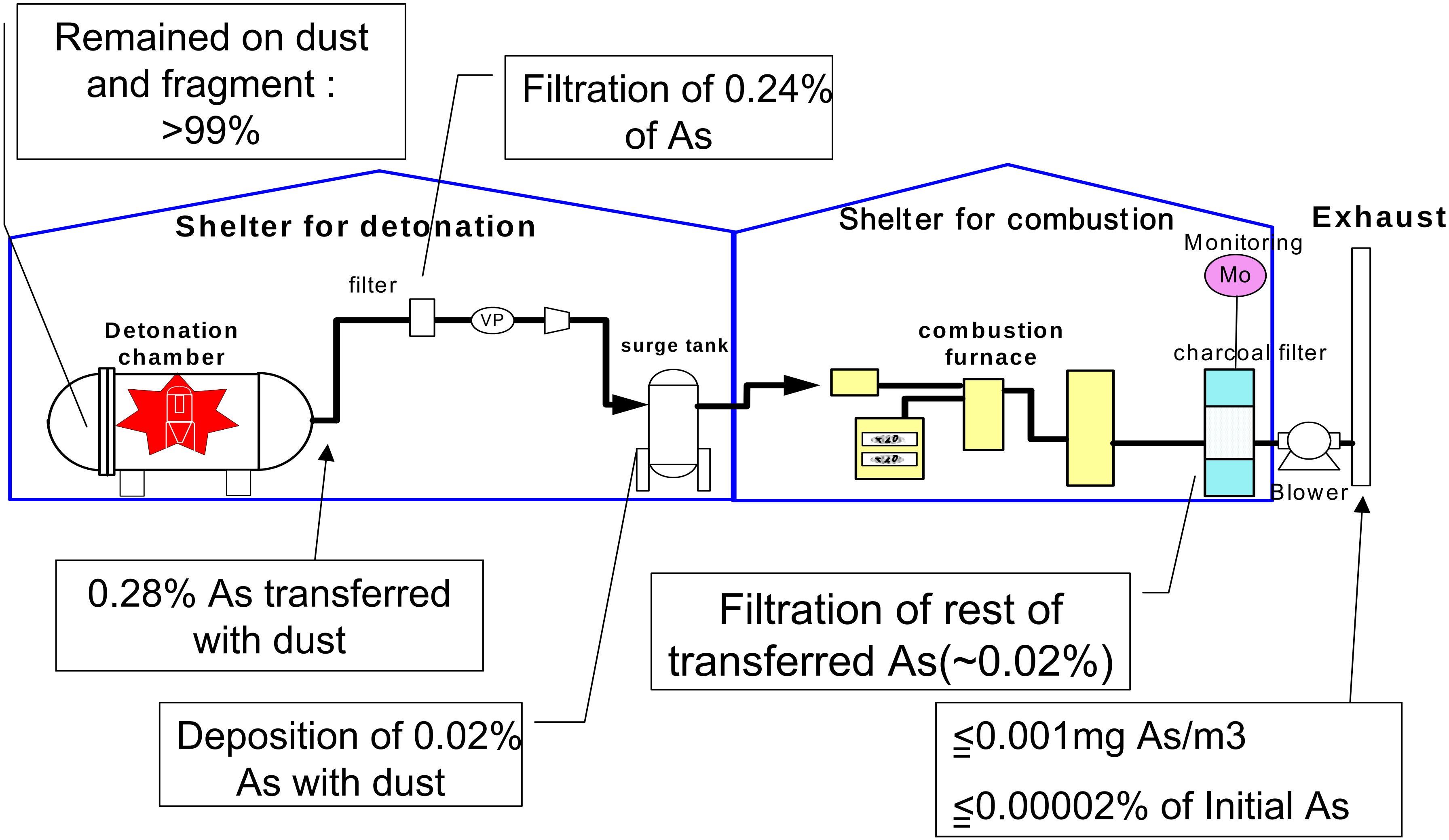
Arsenic behavior of system



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Treatment of fragment and dust

Dust and fragment

↓

Heat treatment to confirm decontamination

↓ Check residual chemical agent by GC-MS

Transfer to proper industrial waste treatment company

↓

Treatment by waste incinerator

Summary

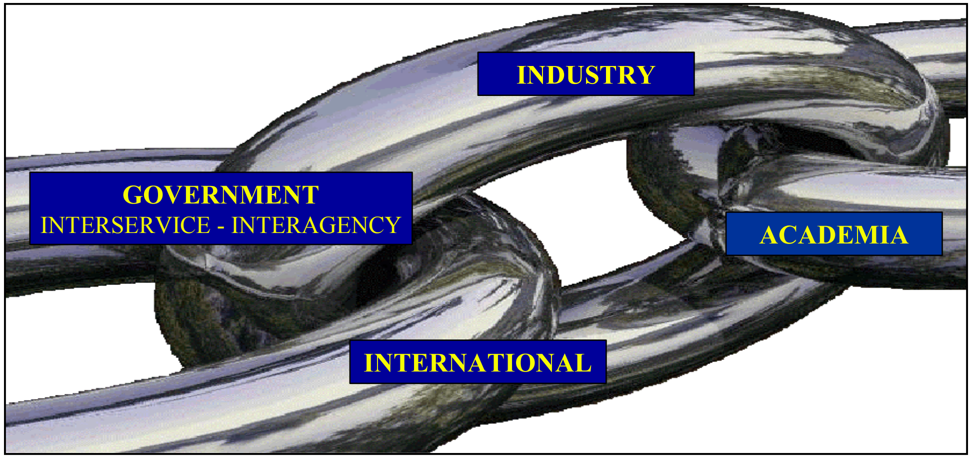
- The arsenic behavior in the Kanda Port Project was studied.
- As in the red bomb was transformed to inorganic compounds after detonation.
- Almost all arsenic in the red bomb was remained in the detonation chamber and a few part around 0.3% was transferred to next plant with suspended air dust.
- Arsenic transferred was filtrated at gas filter and the rest of arsenic transferred was filtrated at the final charcoal filtration system, then the arsenic concentration of exhaust gas was achieved under detection limit, 0.001mg/m^3.

Thank you for your attention

3 May 2006 Briefing to the 14th Global Demil Symposium and Exhibition

James Q. Wheeler
Chair, Munitions Demil/Disposal Subgroup
Director, Defense Ammunition Center

JOCG Munition Demil / Disposal Subgroup



Coordinate munitions demilitarization and disposal programs and activities to include the RDT&E/logistics interface on basic and applied demilitarization and disposal technology; demilitarization and disposal inventories and associated reporting and management; demilitarization and disposal plans and operations; and associated data and information exchanges; monitor and evaluate proposed changes to the Hazardous Waste Disposal Program. Investigate new demilitarization initiatives in advanced disassembly, removal, recovery and reuse, destruction and waste stream treatment.

Joint Ordnance Commander's Group

Principal Members

- **MG Jerome Johnson (Chairman)**
  Commander, AFSC
- **MajGen William D. Catto, USMC**
  Commander, MARCORSYSCOM
- **BG(P) Paul S. Izzo, USA**
  Commander, Picatinny Arsenal, PEO Ammo
- **RDML Archer M. Macy, Jr., USN**
  DC for Warfare Systems Engineering
- **MajGen Kevin J. Sullivan, USAF**
  Commander, Ogden Air Logistics Center
- **RADM Alan S. Thompson, USN**
  Dir, Supply, Ordnance & Logistics Ops Div
  Deputy Chief of Naval Operations (Logistics)

Invited Participants

- **BG P. David Gillett, Jr., USAF**
  Director of Maintenance Office DCS for I&L
- **CAPT Robin C. Husson, USN**
  Deputy EDCA
- **Mr. Anthony J. Melita**
  Deputy Director, Land Warfare and Munitions Office USD (AT&L)
- **COL John A. Merkwan, USA**
  Commander, ARDEC
- **Mr. Gary Motsek**
  Deputy G3, AMC
- **MG James H. Pillsbury, USA**
  Commander, AMCOM
- **BGen Martin Post, USMC**
  HQ, USMC Asst. Dep. Commandant, Aviation
- **Mr. James Q. Wheeler**
  Director, DAC
- **CAPT William Wright, USN**
  Chairman, DDESB

Demil / Disposal Subgroup

Principal Members

- **Mr. James Q. Wheeler (Chair)**
  Director, Defense Ammunition Center
- **LTC Brian W. Raftery, USA**
  Product Manager, for Demilitarization
- **Mr. James Bracey**
  Hill Air Force Base, 84th MUSG
- **Mr. Dan Burch**
  Naval Surface Warfare Center – Crane Division
- **Mr. Jim Taylor**
  MARCORSYSCOM, PM for Ammunition
- **Mr. Jerry Lusk, USN**
  Naval Operational Logistics Support Center

Alternates

- **MAJ Christopher Duffy, USAF**
  HQ USAF / ILEVQ
- **Mr. Wayne Fender**
  Air Force Liaison Office, Rock Island, IL
- **Mr. Lou Ligeno**
  US Army Joint Munitions Command
- **LtCol Tom Noon, USAF**
  HQ USAF / ILEVQ
- **MAJ Steve Veale, USAF**
  Liaison, JMC
- **Michael James, USMC**
  MARCORSYSCOM, PM for Ammunition

Invited Participant

- **Mr. Gary Radicic**
  Office of the EDCA, Liaison to the JMC

Joint Demil/Disposal Efforts

- DoD 5160.65M, Single Manager for Conventional Ammunition
  - ➢ Under revision to replace chapters (e.g., Chapter 13 – Demil/Disposal) with Joint Conventional Ammunition Policies and Procedures (JCAPP 7 – Demil/Disposal).
    - ✓ Jun 05 – 1st rewrite as JCAPP 7
    - ✓ Sep 05 – V17A and V17B (Generic and Specific)
    - ✓ Dec 05 – Revs 18 and 19 with Responsibility Matrix
    - ✓ Jan 06 – V20 without Service Responsibilities in Matrix
    - ✓ Apr 06 – W1, W2 and W3
  - ➢ Nine JCAPPs approved by JOCG Flag Officers on Jan 2006.
- Collaborations with PM Demil
  - ➢ Strategic Planning (PM Demil, Gibbs Lead)
  - ➢ Design for Demil IPT (ARDEC, Mescavage Lead)
  - ➢ Demil R&D IPT (DAC, Nortunen Lead)

Joint Demil/Disposal Efforts

- **MIDAS Initiatives:**
  - Technology Trees Support Service Demil Plans
  - OB/OD Permit Optimization Study
  - Demil Plans Working Group (Joint Service Regulation)
- **Joint Demilitarization Technology Demonstrations**
- **Annual Subgroup Report**
- **ICAP Demil / NDIA Demil Section Meetings**
- **"Demil Express" Spring and Fall Editions**
- **Global Demilitarization Symposium and Exhibition**
- **Annual John L. Byrd, Jr. Award**
- **Demil User's Group Meetings**

Joint Demil/Disposal Efforts

"Demil Express" Newsletter - Spring 2006

- New JMC Commander, BG James E. Rogers
- Updated MIDAS Website Now Available
- Tooling Verification Testing Conducted in Support of Combined Cryofracture/Plasma Demilitarization System Development
- MACS Identification of Chemicals of Concern
- Transition of the Stationary Contained Detonation Chamber
- Magnesium Recovery Technology Moves Closer To Fielding
- DAC Technology Directorate responds to support Eglin AFB
- Ammunition Demil Capability Gaps
- El Dorado Engineering Completes Explosive Waste Incinerator In England

Editor: R. Nick Smith, DAC, 918.420.8139
nick.smith@dac.army.mil

Demil Symposium History

1	Arlington VA	May 1993
2	Arlington VA	May 1994
3	St Louis MO	May 1995
4	Sparks NV	May 1996
5	Sparks NV	May 1997
6	Coeur d' Alene ID	May 1998
7	Tulsa OK	May 1999
8	Coeur d' Alene ID	May 2000
9	Sparks NV	May 2001
10	Lexington KY	May 2002
11	Sparks NV	May 2003
12	Dallas TX	May 2004
13	Reno NV	May 2005
14	Indianapolis IN	May 2006

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION

2006

14th GLOBAL DEMILITARIZATION SYMPOSIUM AND EXHIBITION

1-5 May 2005

The Westin, Indianapolis, IN

Demil Tours of Crane AAA and NSWC Crane

JOHN L. BYRD, JR.

EXCELLENCE IN MUNITIONS DEMILITARIZATION CERTIFICATE

2006

Randal Burcham

JEROME JOHNSON
Major General, US Army
Field Support Command
Chair, Joint Ordnance Commander's Group

BARRY D. BATES
Major General, U.S. Army (Ret)
Vice President, Operations
National Defense Industrial Association

Demil Users Group History

1	Savanna IL	Jan 1994	
2	Davenport IA	Jul 1994	
3	Reno NV	Jan 1995	WADF/HWAD tour
4	McAlester OK	Oct 1995	MCAAP tour
5	Bloomington IN	Oct 1996	CAAA/NSWC tour
6	Pine Bluff AR	Oct 1997	PBA tour
7	Huntsville AL	Oct 1998	Redstone tour
8	Parsippany NJ	Oct 1999	ARDEC tour
9	Lexington KY	Oct 2000	BGAD tour
10	Albuquerque NM	Oct 2001	Sandia NL tour
11	San Diego CA	Oct 2002	Gen Atomics tour
12	Atlanta GA	Oct 2003	ANMC tour
13	Harrisburg PA	Oct 2004	LEMC tour
14	Bettendorf IA	Nov 2005	
15	Las Vegas NV	Oct 2004	29 Palms tour

Demil Users Group Meeting

15th Annual Demil Users Group Meeting

17-19 October 2006

Riviera or Monte Carlo

Las Vegas, NV

Focus: Demil and Scrap Certification

https://www6.osc.army.mil/jg/jdmenu.asp

GENERAL INFO | CALENDAR | JOCG | EXCOM | SUBGROUPS | LINKS

AA - anti-aircraft
AL&T - Acquisition, Logistics and Technology
AAP - Army ammunition plant
ACA - Anniston Chemical Activity
ACALA - Armament and Chemical Acquisition and Logistics Activity
ACAP - Army Career Alumni Program
ACC - Air Combat Command
ACCMO - Ammunition Civilian Career Management Office
AD – Ammunition Depot
ADD - Agency for Defense Development
ADPA - American Defense Preparedness Association (now NDIA)
AEC - U.S. Army Environmental Center
AEDA - Ammunition Explosive and Dangerous Articles
AEMA - Alabama Emergency Management Agency
AET – Advanced Environmental Technology
AETS - Advanced Environmental Technical Services
AFB - Air Force Base
AFCOMAC – U.S. Air Force Combat Ammunition Center
AFMC - Air Force Materiel Command
AFRL - Air Force Research Laboratory
AFSC - Air Force Safety Center
AKM - Army Knowledge Management
AKO - Army Knowledge On-line
ALAAP - Alabama Army Ammunition Plant
AMC - U.S. Army Materiel Command/Air Mobility Command
AMCCOM - U.S. Army Armament, Munitions and Chemical Command - (now IOC)
AMCOM - U.S. Army Aviation and Missile Command
AMCP - Ammunition Management Career Program
AMCPO - Ammunition Management Career Program Office
ANAD - Anniston Army Depot
ANAD-FD - Anniston Army Depot Fire Department
ANCA - Anniston Chemical Activity
ANCDF - Anniston Chemical Agent Disposal Facility
ANG - Air National Guard
ANL - Argonne National Laboratory
ANMC – Anniston Munitions Center
AO - action officer
AOC - Army Operations Center
AOCI - accredited off-campus instructor/instruction
AOT - Applied Ordnance Technology
AP – anti-personnel/ammonium perchlorate/armor piercing
APE - Ammunition Peculiar Equipment
APEMIS - Ammunition Peculiar Equipment Management Information System
APEOPS - Ammunition Peculiar Equipment Operations
APG - Aberdeen Proving Ground
APGSA - Aberdeen Proving Ground Support Activity

API - Armor Piercing Incendiary
APL - anti-personnel landmine
APPOC - Army Power Projection Operations Center
APS - Ammunition Prepositioned Stocks
AQE - Ammunition Quality Evaluation - (now AQS)
AQS - Ammunition Quality Systems
ARA – Applied Research Associates
ARAR – Applicable or Relevant and Appropriate Requirement
ARCENT - U.S. Army Central
ARDEC - U.S. Army Armament Research, Development and Engineering Center
ARL - U.S. Army Research Laboratory
ARL-ALC - U.S. Army Research Laboratory - Adelphi Laboratory Complex
ARMS - armament retooling and manufacturing support
ARNG - Army National Guard
ARNGRC - Army National Guard Readiness Center
ARPA - Advanced Research Projects Agency
ARPRINT - Army Program for Individual Training
ARPS - ASMIS Retrieval and Processing System
ARS – Automatic Requisitioning System
ARSR - Air Route Surveillance Radar
ARSTAF - Army Staff
ARTASK - U.S. Army Training and Security Kuwait
ARTS - Automated Reports of Discrepancy Tracking System
ASA - Assistant Secretary of the Army
ASAD – Army Safety Augmentation Detachment
ASAIE - Office of Assistant Secretary of the Army for Installations and Environment
ASAP - Army Strategic Action Plan/as soon as possible
ASB - Army Science Board
ASC – Army Support Command (in Korea)
ASD - Assistant Secretary of Defense
ASE - Ammunition Support Equipment
ASF – Army Stock Fund/Army Surveillance Facility
ASI - Advanced Sciences, Inc.
ASIM - Ammunition School Intern Manager
ASIS - Ammunition Surveillance Information System
ASIT - Ammunition Storage Information Team
ASME - American Society of Mechanical Engineers
ASMIS - Army Safety Management Information Systems
ASMP - Army Strategic Mobility Program
ASP - ammunition supply point
ASQ - American Society for Quality
ASQAP - Ammunition Surveillance/Quality Assurance Plan
ASR - Archives Search Report
ASRP - Ammunition Stockpile Reliability Program
ASRS - Air Surveillance Radar Site
AST - Ammunition Support Team

ASTMIS - Army Science and Technology Management Information System
ASW - ammunition surveillance workshop
ATAAPS - Automated Time Attendance and Production System
ATACMS - Army Tactical Missile System
ATACS - Automated Tactical Ammunition Classification System
ATAMS - Automated Training Ammunition Management System
ATC - U.S. Army Aberdeen Test Center
ATCOM - U.S. Army Aviation and Troop Command
ATEC – Army Test and Evaluation Command
ATF – Armament Technology Facility
ATGM - anti-tank guided missile
ATK – Alliant Techsystems
ATKPG – Alliant Techsystems Proving Ground
ATM - Anti-Tactical Missile/Automated Teller Machine
ATRRS - Army Training Requirements and Resources System
AUES – American University Experimental Station
AUR - All-Up-Round
AUSA - Association of the United States Army
AVCRAD - Aviation Classification and Repair Activity Depot
AWCF - Army Working Capital Fund
AWMA - Air and Waste Management Association
AWPA - American Wood Preservers' Association
AWPS - Army Workload and Performance System
AWR - Army War Reserve
AWRSPTCMD – Army War Reserve Support Command
AWS - Air Warning System/alternative work schedule

BA - biological assessment
BAA - Broad Agency Announcement
BAAAP - Badger Army Ammunition Plant
BAAF - Briggs Army Airfield
BAH - Booz Allen and Hamilton
BASEOPS – Base Operations
BAT - Brilliant Anti-Armor Technology
BATF - Bureau of Alcohol, Tobacco, and Firearms
BATS - Ballistic Aerial Target System
BBS - bulletin board system
BBTS - Big Black Test Site
BCT - BRAC Cleanup Team
BCU - Battery Coolant Units
BD - base detonating
BDM - Bunker Defeating Munitions
BDO - Battledress Overgarment
BEC - Base Environmental Coordinator
BED - Battlefield Environment Directorate
BER - Budget Execution Review

BES - budget estimate submission
BET - Building Effective Teams
BG - Brigadier General
BGAD - Blue Grass Army Depot
BGCA - Blue Grass Chemical Activity
BGR - Bombing and Gunnery Range
BHAD - Black Hills Army Depot
BIP – blow-in-place
BL - basic load
BLAHA - basic load ammunition holding area
BLASA - basic load ammunition storage area
BLM - Bureau of Land Management
BLU - bomb load unit
BMO - Business Management Officer
BMDO - Ballistic Missile Defense Organization
BOD – Board of Directors
BOE - Bureau of Explosives
BOI – basis of issue/Board of Investigation
BOM - Bureau of Mines
BOS - Battlefield Operating Systems
BPFTF - Blossom Point Field Test Facility
BPI - Business Process Improvement
BPM - Business Process Model
BPRF – Blossom Point Research Facility
BPRR - Budget and Program Resources Review
bps - bytes per second
BPTA - Baywood Park Training Area
BQ - best qualified
BRAC - Base Realignment and Closure
BRDEC - U.S. Army Belvoir Research, Development and Engineering Center
BTC - Base Transition Coordinators
BULLET - Brilliant Life-Cycle Logistical Evaluation Technology
BWM - biological warfare materiel
BXA – Bureau of Export Administration

CA - competent authority
CAA - competent authority approval/classification competent authority
CAAA - Crane Army Ammunition Activity
CAB - current awareness bibliography
CABS - cockpit airbag system
CAD - cartridge actuated device/conventional ammunition demilitarization
CAD/CAE - computer-aided design/computer-aided engineering
CADD - computer-aided design and drafting
CADS - Containerized Ammunition Distribution System
CAI - Controlled Air Incinerator
CAIG - Centralized Accident Investigation, Ground

CAIMS - Conventional Ammunition Information Management System
CAIRA - Chemical Accident and Incident Response and Assistance
CAIS - chemical agent ID set
CAL - College of Army Leadership
CALL - Center for Army Lessons Learned/Combined Automated Lessons Learned
CALS - Committee for Ammunition Logistics Support
CAM - chemical agent monitor
CAMA - California/Arizona Maneuver Area
CAMDEG - Containerized Ammunition Missile Distribution Executive Group
CAMDS - Chemical Agent Munitions Disposal System
CAMIN - Chemical Accountability Management Information Network
CAMO - Conventional Ammunition Management Office
CAMP - Council on America's Military Past
CAP – Corrective Action Plan
CAPEX – Capabilities Exercise
CAPR - Capability Request
CAPT - Captain (Navy)
CAPULDI - Conventional Ammunition Packaging and Unit Load Data Index
CARC - chemical agent resistance coating
CARP - Computerized Ammunition Readiness Predictor
CART - Conventional Ammunition Radiation Training
CAS - Combat Ammunition System
CASARM - Chemical Agent Standard Analytical Reference Material
CASCOM - U.S. Army Combined Arms Support Command
CASHPAC - Chemical Agent Safety and Health Policy Action Committee
CASME - Chemical Agent Safety Management Evaluation
CASY - Chemical Agent Storage Yard
CATF - Combined Arms Training Center
CATM - Captive Air Training Missile
CAWCF - Conventional Ammunition Working Capital Fund
CB - chemical/biological
CBDCOM - U.S. Army Chemical and Biological Defense Command - (now SCBCOM)
CBA - Cost Benefit Analysis
CBI - Clean Burning Igniter
CBIRF - chemical biological initial response force
CBQRF - chemical, biological Quick Response Force
CBT - computer-based training
CBU - cluster bomb unit
CC - condition code
CCAD - Corpus Christi Army Depot
CCB – Configuration Control board
CCC - Command, Control, Communications
CCCB - Corporate Configuration Control Board
CCL - combat configured load
CCPAT - Chemical Container Process Action Team
CCPM - command career program manager

CCR - certificate of compelling reasons
CCS – Chemical Compliance Systems
CCSS - Commodity Command Standard System
CCTV – closed circuit television
CCU - Canard Control Unit
CD – Closed Disposal
CDA – Catalog Data Activity/Central Design Activity
CDC – contained detonation chamber
CDF – Chemical Agent Disposal Facilities
CDi - interactive compact disk
CDIP - Combined Defense Improvement Program
CDR - commander
CDRA - Chemical Demil Research Agency
CD-ROM - Compact Disk - Read Only Memory
CDRS - Container Design Retrieval System
CDT - Closed Disposal Technology
CDTF - Chemical Demilitarization Training Facility
CE - conditioned exemption
CEA – Civilian Executive Assistant
CEB – Combat Equipment Battalion
CEB-AF - U.S. Army Combat Equipment Base - Afloat
CECOM - U.S. Army Communications-Electronics Command
CEE - Civilian Employment Estimate
CEHNC-OE-CX - U.S. Army Engineering and Support Center, Huntsville, Ordance and Explosives Center for Expertise
CEIBO - Chemical Equipment for Industrial Base Operations
CELDi – Center for Engineering Logistics and Distribution
CELMS - Corps of Engineers, Lower Mississippi Valley - St. Louis Division
CEM - Continuous Emissions Monitoring
CENCR - Corps of Engineers, North Central Region
CENTCOM - Central Command
CEO - Career Enhancement Opportunity
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CERL - Construction Engineering Research Laboratory
CERT - Cost Effectiveness Risk Tool
CESWA - Corps of Engineers, Southwest Area
CFC – chlorofluorocarbons/Combined Federal Campaign
CFD - Container Fleet Division
CFE - Conventional Forces Europe
CFM - CONUS freight management
CFR - Code of Federal Regulations
CFTF - climatic firing testing facility
CG - Commanding General/compatibility group
CHA - Container Handling Area
CHAAP – Cornhusker Army Ammunition Plant
CHEMSURETYPAC - Chemical Surety Policy Action Committee

CHP - chemical hazard prediction
CHP-DM - Chemical Hazard Prediction for Decision Makers
CHU - Container Handling Unit
CID - component identification/Criminal Investigation Division
CIM - Corporate Information Management
CINCPAC - Commander in Chief, Pacific
CINCUSAREUR - Commander-in-Chief, U.S. Army, Europe
CIO - Container Integration Office/Corporate Information Officer
CiPPS - Civilian Integration into the Army Personnel Proponent System
CIR - Chemical Investigation Report
CIRS - Command Integrated Resource Submit
CLDP - Civilian Leader Development Program
CLEVER - Closed Loop Energetics with VOC Emission Reduction
CLRP - Command Logistics Review Program
CLRT - Command Logistics Review Team
CLRTX - Command Logistics Review Team - Expanded
CLT - Container Load Trailer
CLUB – Configured Load Unit Building
CMDA - U.S. Army Chemical Materiel Destruction Agency
CMSgt - Chief Master Sergeant
CMSL - Chemical Materials Screening Laboratory
CMT - Configuration Management Team
CNO - Chief, Naval Operations
CNSDP - Chemical Non-Stockpile Disposal Program
CO - contracting officer
CO2 – Consideration of Others
COE - Certificate of Equivalency/chief of engineers
COF - Civilian Objective Force
COFC - container-on-flatcar
CofS - Chief of Staff
COL - Colonel
COMM - Department of Commerce
COMNAVFORKOREA - Naval Force Commanders, Korea
CONEX - container express
CONUS – Continental United States
CONWEP - Conventional Weapons Effects Program
COOP - Continuity of Operations Plan
COR - Contracting Officer Representative
COREDOC - core documents
COSATI - Committee on Scientific and Technical Information
COSCOM – corps support command
COSIN - Control Staff Instruction
COTP - Captain of the Port
CP - career program/concrete piercing
CPAC - Civilian Personnel Advisory Center
CPD - Competitive Professional Development

CPIA - Chemical Propulsion Information Agency
CPM - career program manager
CPMS XXI - Civilian Personnel Management System XXI
CPO – chief petty officer/Civilian Personnel Office
CPOS - civilian personnel occupational standards
CPP - Civilian Personnel Pay
CPPC – Career Program Policy Committee
CPRP - Chemical Personnel Reliability Program
CPSC - Consumer Products Safety Commission
CPT - Captain (Army/Air Force)
CPU – central processing unit/Chemical Protective Undergarment
CQE - Certified Quality Engineers
CRA - Continuing Resolution Authority
CRC – CONUS Replacement Center
CRDA - Cooperative R&D Agreement
CREST - Career-Related Experience in Science & Technology
CROP - Container Roll In/Roll Out Platform
CRRC - Construction Requirements Review Committee
CRTC – Cold Regions Test Center
CS – cone stabilized/Combustion Subcommittee
CSA - Chief of Staff, U.S. Army/Corps Storage Area
CSC - Convention for Safe Container/Computer Sciences Corporation
CSDP - Chemical Stockpile Demilitarization Program/Chemical Stockpile Disposal Program/Command Supply Discipline Program
CSDS - Chemical Stockpile Demilitarization System
CSEPP - Chemical Stockpile Emergency Preparedness Program
CSI - Chemical Surety Inspection
CSM - chemical surety materiel/Command Sergeant Major
CSP - cleanup site plan
CSRFCERP - Chemical Service Response Force Commander's Emergency Response Plan
CSS - Coastal Systems Station/Constant Surveillance Service/chemical site submission/chemical safety submission
CTC - Chemical Treaty Compliance
CTED - Civilian Training, Education, and Development
CTT – Closed, Transferring, and Transferred
CTX - Center for Technical Exchange
CVRC - Center for Verification Research
CW - chemical weapons
CWC - chemical weapons convention
CWDMUG - Chemical Weapons Data Management Users Group
CWI - Certified Welder's Inspection
CWM - chemical warfare materials
CWO - Chief Warrant Officer
CWP - contaminated waste processor
CWPLU - contaminated waste processor large unit

DA – Department of the Army
DAC - U.S. Army Defense Ammunition Center
DAAMS – Depot Area Air Monitoring System
DACSC – Department of the Army Chemical Agent Safety Council
DAESC - Department of the Army Explosives Safety Council
DAF – Department of the Air Force
DAIG - Department of the Army Inspector General
DAIMBO - DA Installation Management BRAC Office
DAITM - Department of the Army Investigation Team for Malfunctions
DALA - see AMMOLOG
DALP - Digital Ammunition Photo Library
DAM - Demolition Attack Munition
DAO – Directorate for Ammunition Operations/Division Ammunition Officer
DAPC - Defense Ammunition Packaging Council
DAPS - Defense Automated Printing Service
DARSE - Department of the Army Relocation Services for Employees
DAS - Director of the Army Staff
DASA(ESOH) - Deputy Assistant Secretary of the Army (Environment, Safety and Occupational Health)
DASAF - Director of Army Safety
DAU – Defense Acquisition University
DAVIS - Defense Automated Visual Information System
DBA - delivery by appointment
DBE - dry bay extinguisher
DBMS - Data Base Management Systems
DBOF - Defense Business Operating Fund
DCAS - Defense Contracting Administrative Services
DCD - Deseret Chemical Depot
DCG - Deputy Commanding General
DCGPR - Deputy Commanding General for Procurement and Readiness
DCG(T) - Deputy Commanding General – Technologies
DCI – Donovan Commercial Industries
DCMAO - Defense Contract Management Area Office/Defense Contract Management Area Operations
DCMC - Defense Contract Management Command
DCO – deputy commanding officer/Dial Central Office
DCPS - Defense Civilian Pay System
DCSCBM - Deputy Chief of Staff for Chemical and Biological Matters
DCS for Ammo - Deputy Chief of Staff for Ammunition
DCS, G4 - Deputy Chief of Staff, G4
DCSOPS - Deputy Chief of Staff for Operations and Plans
DCSPER - Deputy Chief of Staff for Personnel
DCSPIM - Deputy Chief of Staff for Personnel and Installation Management
DCSRDE - Deputy Chief of Staff for Research, Development and Engineering
DCSRM - Deputy Chief of Staff for Resource Management
DCT - Demilitarization Contracting Team

DCX - Direction and Control Exercise
DC-X - Delta Clipper Experimental
DD – Decision Documents
DDA – Designated Disposition Authority
DDC - Defense Distribution Center
DDESB - Department of Defense Explosives Safety Board
DDESTSG - Department of Defense Explosives Safety Testing Steering Group
DDN - Defense Data Network
DE - Designer's Edge
DEA - Data Exchange Agreement/Drug Enforcement Administration
DECM – Directorate of Environmental Complaints and Management
DEEWIN - Defense Environmental Explosives Waste Information Network
DEFAC - Demilitarization Facility
DEH - Directorate of Engineering and Housing
DENIX - Defense Environmental Network and Information Exchange
DEPMED - deployable medical
DERP - Defense Environmental Restoration Program
DERTF - Defense Environmental Restoration Task Force
DES - Department of Emergency Services
DESCIM - Defense Environmental Security Corporate Information Management
DESCOM - U.S. Army Depot System Command
DESMS - Defense Explosives Safety Management System
DESOH - Deputy for Environmental Safety and Occupational Health
DFAS - Defense Finance & Accounting Services
DFD - Design for Demil
DFS - deactivation furnace system
DGIS - DOD Gateway Information System
DIA - Defense Intelligence Agency
DID - data item description
DIRT – Depot Incident Response Team
DISA - Defense Information Systems Agency
DISUM – Defense Information Summary
DL - Distance Learning
DLA - Defense Logistics Agency
DLAMP - Defense Leadership and Management Program
DLAPS - Defense Logistics Agency Publishing System
DLIS - Defense Logistics Information Service/ Defense Logistics Information System
DLN - Defense Libraries Network
DLSC - Defense Logistics System Center
DLSIE - Defense Logistics Studies Information Exchange
DMA – Director for Munitions and Armaments
DMATS - Defense Metropolitan Area Telephone Service
DMC - Defense Mega Center/Defense Movement Coordinators
DMIS - Defense Mapping Information Service
DMSMS - Diminishing Manufacturing Sources and Material Shortages
DMSO - Defense Modeling and Simulation Office

DMVT – DAC Munitions Virtual Tool
DMWR - depot maintenance work requirements
DN - Department of the Navy
DNA - Defense Nuclear Agency
DNRP - Defense National Relocation Program
DNT - dinitrotoluene
DOC - Department of Corrections
DOD - Department of Defense (Army uses all caps; Department of Defense & other Services use DoD)
DODAC - Department of Defense Ammunition Code
DODCS - DOD Constant Surveillance
DODESTSG - DOD Explosives Safety Testing Steering Group
DODI – Department of Defense Instruction
DODIC - Department of Defense identification code
DODIG - Department of Defense Inspector General
DODSASP - DOD Small Arms Serialization Program
DOE - Department of Energy
DOI - Department of the Interior
DOIM - Director of Information Management
DOJ - Department of Justice
DOL – Director for Logistics
DON - Department Of the Navy
DOS - Disk Operating System
DOT - Demil Operations Team/Department of Transportation
DOTSI – Department of Transportation Safety Institute
DPG - Dugway Proving Ground
DPICM – Dual Purpose Improved Conventional Munitions
DPMS - Demil Planning and Management System
DPR - Defense Performance Review
DPS – Defense Printing Service (now DAPS)
DPVR - Door Post Vertical Retainers
DPW - Department of Public Works
DRB - Division Ready Brigade
DRC - Dynamics Research Corporation
DRD IPT- Demil Research and Development Integrated Processing Team
DRID #20 – Defense Reform Initiative Directive 20
DRMO - Defense Reutilization and Marketing Office
DRMS - Defense Reutilization and Marketing Services
DROLS - Defense RDT&E On-line System
DSACS - Defense Standard Ammunition Computer Subsystem
DSB - Defense Science Board
DSN – Defense Switch Network
DSR - depot surveillance record
DSREDS - Digital Storage and Retrieval Engineering Data System
DSWA - Defense Special Weapons Agency
DTC - Desert Training Center/U.S. Army Developmental Test Command (formerly

TECOM)
DTF - Duck Target Facility
DTIC - Defense Technical Information Center/Defense Technologies and Industrial Cooperative Committee
DTMR - Defense Traffic Management Regulation
DTR - Defense Transportation Regulation
DTS - Defense Transportation System
DTTS - Defense Transportation Tracking System
DTV - Desktop Video
DU - Depleted Uranium
DUSD(ES) - Deputy Under Secretary of Defense (Environmental Security)
DZHC - Day Zimmermann Hawthorne Corporation

E-FAPP – Enhanced – Field Artillery Projectile Pallet
EA – Edgewood Area/Environmental Assessment
EA-CTC - Executive Agent for Chemical Treaties Compliance
EAGLE - Employees' Access to Gainful and Lasting Endeavors
EAT - External Aerial Transport
EBS - Environmental Baseline Survey
EC - Executive Committee
ECA - Edgewood Chemical Activity
ECAB - electronic current awareness bibliography
ECAP - Environmental Considerations for Ammunition Personnel
ECM - earth-covered magazine
ECP - engineering change proposal
ECR - Executive Country Review
ECS - Electronic Communications Systems
ECWCS - extended cold weather clothing system
EDCA - Executive Director for Conventional Ammunition
EDCARS - Engineering Data Computer Assisted Repository System
EDES - Executive Director for Explosives Safety
EDIO - Executive Director for Industrial Operations
EDMS - Engineering Drawings Management System
EDR - Event Data Recorder
EDS – Emergency Destruction System/Explosives Destruction System
EDRE - Emergency Deployment Readiness Exercise
EE/CA - Engineering Evaluation/Cost Analysis
EED - electro-explosive devices
EEO - Equal Employment Opportunity
EFI - Exploding Foil Initiator
EFOGM - Enhanced Fiber Optic Guided Missile
EFT – Electronic Fund Transfer
EGDW - Engineering Graphic Display Workstation
EGW - Engineering Graphics Workstations
EIC - Electronic Imaging Centers
EIS - Enterprise Information System/Environmental Impact Statement

EIT - Emerging Information Technology
EITM - Environmental Information Technology Management
ELDP - Executive Leader Development Program
EM - electromagnetic
EMA - Emergency Management Agency
E-Mail - electronic mail
EMC - Energetic Materials Center/Energetic Materials Conference
EMI - Emergency Management Institute/Ernst Mach Institute
EMIC - Electronic Multimedia Imaging Center
EMIS - Emergency Management Information System
EMR - electromagnetic radiations
EMRTC - Energetic Materials Research and Testing Center
EMT - Emergency Medical Technician
EMWOG - Executive Management Working Group
EO - ethylene oxide/executive order
EOC - Emergency Operations Center
EOD - explosives ordnance disposal
EOM - Expendable Ordnance Management
EOMMAC - Excess and Obsolete Munitions Management Advisory Committee
EOR - Element of Resource
EOSC – Eastern Oklahoma State College
EP – Engineer Pamphlet
EPA - U.S. Environmental Protection Agency
EPC - Environmental Performance Cooperative
EPCA - Environmental Protective Cover Assemblies
EPCRA - Emergency Planning and Community Right-to-know Act
EPF - Enhanced Palletized Flatrack
EPLARS – Enhanced Precision Location Reporting System
EPM - Energetics Processing Module
EPP – Enhanced Producibility Program
EPRI - Energy Producers Research Institute
EPSS - Electronic Performance Support Systems
EQA - Engineer Qualification Area
EQCC - Environmental Quality Control Committee
ERA - Enhanced Researcher Access
ERASDAC - Explosion Risk and Structural Damage Assessment Code
ERDEC - U.S. Army Edgewood Research, Development and Engineering Center
ERGM – Extended Range Guided Munitions
ES - exposed site/extended range
ESAV - Explosives Safety Assistance Visit
ESB – Explosives Safety Bulletin
ESC - Executive Steering Committee
ESD - electrostatic discharge
ESI - expanded site inspection/explosives safety inspection
ESIDB - Explosives Safety Information Data Base
ESIMS - Explosives Safety Information Management System

ESMAM - Explosives Safety Mishap Analysis Module
ESMB - Explosive Standoff Minefield Breaching/Explosives Safety Management Board
ESMDB - Explosives Safety Mishap Data Base
ESMS – Explosives Safety Management System
ESPM - Explosives Safety Policy Memorandum - (now ESSM)
ESS - explosives safety standards/explosives safety submission/Explosives Safety Siting
ESSM - Explosives Safety Standards Memorandums
ESSOLANT - Atlantic Explosives Safety Support Office
ESTC - Explosives Storage and Transport Committee
ESTCP - Environmental Security Technology Certification Program
ESTMS – Explosives Safety Technical Manual System
ETO - Exercise Training Officer
ETOS - Electronic Travel Order System
EUSA - Eighth U.S. Army
EWI - explosive waste incinerator
EXPLAN - exercise plan

FAA - Federal Aviation Administration/Functional Area Assessment
FAASV - Field Artillery Ammunition Supply Vehicle
FAD – Force/Activity Designator/Funding Authorization Document
FAE - fuel air explosive
FAPP - Field Artillery Projectile Pallet
FARP - forward area rearm/refuel point
FARV - Future Armored Resupply Vehicle
FASCAM - family of scatterable mines
FASP – field ammunition supply point
FAT - First Article Test
FC - functional chief
FCC - Federal Communications Commission
FCCB - Functional Configuration Control Board
FCDNA - Field Command, Defense Nuclear Agency
FCP - Field Command Post
FCR/MCPM - Functional Chief Representatives and Major Army Command Career Program Managers
FCTCLANT - Fleet Command Training Center, Atlanta
FCU – Fragmentation Containment Unit
FDDI - fiber distributed data interface
FEA - Finite Element Analysis/functional economic analysis
FEDLINK - Federal Library and Information Network
FEDLOG - Federal Logistics Data on Compact Disk
FEMA - Federal Emergency Management Agency
FEMIS - Federal Emergency Management Information System
FESWG - Fuze Engineering Standardization Working Group
FFCA - Federal Facility Compliance Act
FHC - final hazard classification

FLICC - Federal Library and Information Center Committee
FLIS - Federal Logistics Information System
FLOW – Focused Logistics Wargame
FMS – Foreign Military Sales
FMTV - Family of Medium Tactical Vehicles
FOIA - Freedom of Information Act
FONSI - Finding of No Significant Impact
FORSCOM - Forces Command
FOST - Finding of Suitability to Transfer
FPUI - First Production Unit Inspection
FRA - Federal Railways Administration/Former Raritan Arsenal
FRC - Federal Records Center
FRTP - Final Range Transfer Plan
FRTR – Final Range Transfer Report
FSAC - Fire Support Armament Center
FSC - Federal supply classification/Functional Standing Committee/U.S. Army Field Support Command (PROV)
FSD - fragmentation suppression device
FSHC – Federal Safety and Health Conference
FSS – Field Storage Site/Federal Supply Schedule/Federal Supply Service/
Fragmentation Suppression Shields
FSX - full-scale exercise
FSU - Former Soviet Union
FTIR - Fourier transform infrared
FTOS - Flight Termination Ordnance System
FTP - file transfer protocol
FUDS - formerly used defense sites
FWDA - Fort Wingate Depot Activity
FWDC - Foster Wheeler Development Corporation

GAC-FBR – Granulated Activated Carbon-Fluidized Bed Reactor
GACIAC – Guidance and Control Information Analysis Center
G&C - guidance and control
GAO - General Accounting Office
GASP - grazing angle strain polarimeter
GAT - Government Acceptance Test
GBI – Ground Base Interceptor
GBL - Government Bill of Lading
GC99 – golden cargo 99
GC00 – golden cargo 00
gc/ms - gas chromatograph/mass spectrometer
GCS - guidance and control sections
GCSS – ground combat and support systems
GDOS – General Dynamics Ordnance Systems
GDW - Graphic Display Workstation
GEM – Green Energetic Materials

GES - Global Environmental Solutions, Inc.
GGG - gas grain generator
GIS - Geographic Information System
GMLR - Guided Missile and Large Rocket
GO - General Officer
GP - general purpose/gun position
GPO – Government Printing Office
GPS – Global Positioning System
GRASS - Geographical Resources Analysis Support System
GSA - General Services Administration
GST - Gulf Strike Team
GTA - Graphic Training Aid
GTN - Global Transportation Network
GTS - Global Transportation System
GUI - Graphical User Interface
G/VLLD - Ground/Vehicular Laser Locator Designator

HAAF - Hunter Army Airfield
H&H - Handy & Harman
HAP - Hazardous Air Pollutants/housing assistance program
HARM - High-Speed Antiradiation Missile
HAS - Headquarters Application System
HAZMAT - hazardous materiels/hazardous materials (49CFR)
HAZWOPER - Hazardous Waste Operations and Emergency Response
HBCU - Historically Black Colleges and Universities
HC - hazard classification/hexachloroethane
HCP - hot cargo pad
HCSDS - hazardous component safety data statement
HD - Hazard Division
HDD - hazardous devices division
HDOGIS - Humanitarian Demining Operations Geographic Information System
HEARTS - Honesty, Ethics, Accountability, Respect, Trust, and Support
HEDP – High Explosive Dual Purpose
HEMAT - Heavy Expanded Mobility Ammunition Trailer
HEMTT - Heavy Expanded Mobility Tactical Truck
HERO - hazards of electromagnetic radiation to ordnance
HETT - Heavy Equipment Transport Trailer
HEW - high explosives weight
HHG – Household Goods
HGD - hot gas decontamination
HIMARS - High Mobility Artillery Rocket System
HMCC – Hazardous Materiel Control Center
HMDS - Hazardous Material Data Sheets
HMIS - Hazardous Materiel Information System
HMMWV - High Mobility Multipurpose Wheeled Vehicle
HMT - High Mobility Trailer

HO - handout
HPE - Hispanic Professional Engineers
HPLC - high performance liquid chromatography
HPM - High-Performance Magazine
HQ – headquarters/highly qualified
HRS - Historical Records Searches
HRSG - Human Resource Subgroup
HSAAP - Holston Army Ammunition Plant
HSMS - Hazardous Substances Management System
HSP – high security padlock/High-Speed Printer
HSS - Hazard Separation System
HTF - Housing, Timing, and Fuzing
HTML - Hyper Text Markup Language
HTO - hydrothermal oxidation
HTRW - hazardous, toxic, and radioactive waste
HTW - hazardous and toxic waste
HW - hazardous waste
HWAD - Hawthorne Army Depot
HWIR - Hazardous Waste Identification Rule
HVAC - Heating, Ventilation, & Air Conditioning
HVAR – High Velocity Aircraft Rocket

IAAAP - Iowa Army Ammunition Plant
IAG - interagency agreement
IART – Impact Area Review Team
IBCT – Initial Brigade Combat Team
IBD - inhabited building distance
IBQD - inhabited building quantity distance
IBS - Integrated Baseline System
IC – Ion Chromatography
ICAP - Industrial Committee for Ammunition Producers
ICAPP - Integrated Conventional Ammunition Procurement Plan
I-CASE - Integrated Computer Aided Systems Engineering
ICBM - Intercontinental Ballistic Missile
ICD - Interface Control Document
ICIEEC – ICI Explosive Environmental Company
ICE – Interagency Committee on Explosives/Inventory Control Effectiveness
ICM - Improved Conventional Munitions
ICT – Integrated Concept Team
IDA - Institute for Defense Analysis
IDEF - Information Definition Language
IDEM - Indiana Department of Environmental Management
IDF – Israeli Defense Force
IDP - Integration Decision Paper
IDS - Intrusion Detection System
IE – Internet Explorer

I&E – Installations & Environment
IEC - U.S. Army Industrial Engineering Command
IEE - Institute of Electronic Engineers
IEM - Innovative Emergency Management
IES - Institute of Environmental Sciences
IH - industrial hygienist
IHC - interim hazard classification
IHF - Interim Holding Facility
IHP - Iron Head Powder
IICL - Institute of International Container Lessors
IITRI - Illinois Independent Technical Research Institute
IJPAT - Information Joint Process Action Team
IL - intraline
ILDC - Intern Leadership Development Course
ILGS - Industrial Logistics System
ILL - interlibrary loan
ILLINET - Illinois Library Network
ILS – integrated logistics support/Internet Locator Service
ILSC - U.S. IOC Industrial Logistics Systems Center
ILSMT - Integrated Logistics Support Management Team
ILSP - Integrated Logistics Support Plan
IM - information management/insensitive munitions
IMA - Information Mission Area
IMAAP - Information Mission Area Action Plan
IMAC - Information Management Advisory Council
IMB - Insensitive Munitions Board
IMCC - Insensitive Munitions Coordination Council
IMCP - Internal Management Control Program
IMDG - International Maritime Dangerous Goods
IMHS - Igloo Munitions Handling System
IMMC - Integrated Materiel Management Center
IMPACT - Insensitive Munitions Packaging Technology
IMR - Installation Mission Review
IMS - International Military Students/Ion Mobility Spectrometer
IMSC - Information Management Support Council
IMSD - Integrated Management Systems Division -(formerly SPCC)
IMSO - International Military Student Officer
IMSRC - Information Management Systems Review Committee
INAAP - Indiana Army Ammunition Plant
INFOCON – Information Operations Condition
INNOLOG - Innovative Logistics Techniques, Inc.
INPR - Inventory Project Reports
IOB - Internal Operating Budget
IOP - Illinois Ordnance Plant/internal operating procedure
IP - Implementation Plan/Informational Program/Internet Protocol
IPF - ISO-Compatible Palletized Flatrack

IPR - in-process review
IPT - Integrated Process Team
IR - infrared/interim removal
IR&D - information, research and development/Independent Research and Development
IRC - initial ready company
IRF – Idaho Research Foundation
IRFX - initial response force exercise
IRI - initial receipt inspection
IRIS - Inferential Retrieval Indexing System
IRP - Installation Restoration Program/Installation Restoration Project
IRTC - Infantry Replacement Training Center
IRZ - Initial Response Zone
ISA - Interservice Support Agreement
ISAC - Intermediate Systems Acquisition Course
ISCE - Information Systems Cost Estimate
ISDN - Integrated Services Digital Network
ISM - Installation Support Module
ISO - International Organization for Standardization
ISPI – International Society for Performance Improvement
ISR - Interim Safety Release
ISRC – Intelligent Systems and Robotics Center
ISSN - International Standard Serial Number
ISUG - International Sirsi User's Group
ITC - Instructor Training Course
ITMC - Installation Traffic Management Course
ITO - Installation Transportation Officer
ITR – Independent Technical review
ITRO - Interservice Training Review Organization
ITSB - Information Technology Systems Budget

JACADS - Johnston Atoll Chemical Agent Disposal System
JAD - Joint Application Development
JAG - Judge Advocate General
JAMSS – Joint Ammunition Management Standard System
JANNAF - Joint Army-Navy-NASA-Air Force
JASSM - Joint Air-to-Surface Standoff Missile
JBD – Joint Board of Directorate
JCABS - joint cockpit airbag system
JCAPP - Joint Conventional Ammunition Policies and Procedures
JCS - Joint Chiefs of Staff
JDS - Joint Demil Study
JDT - Joint Demil Technology
JDTC - Joint Development Training Center
JDTP - Joint Demilitarization Technology Program
JEDMICS - Joint Engineering Data Management Information and Control System
JEL - Joint Electronic Library

JHARS - Joint Hazard Automated Retrieval System
JHC - Joint Hazard Classifiers
JHCS - Joint Hazard Classification System
JI - Johnston Island
JIC - Joint Information Center
JICWG - Joint Intermodal Container Working Group
JILWG - Joint Intermodal Logistics Working Group
JIS - Joint Information System
JLC - Joint Logistics Commanders
JLOTS - Joint Logistics Over the Shore
JLSC - Joint Logistics Systems Center
JMC - Joint Mobility Center
JMHA - Japanese Missile Holding Area
JMTCA – Joint Munitions Transportation Coordinating Activity
JOAAP - Joliet Army Ammunition Plant
JOCG - Joint Ordnance Commanders Group
JOCGMMSSG - Joint Ordnance Commanders Group Munitions Management Systems Subgroup
JOCGOSSG - Joint Ordnance Commanders Group Ordnance Safety Subgroup
JOCMTSG - Joint Ordnance Commanders Munitions Training Subgroup
JOCOTAS - Joint Committee on Tactical Shelters
JON - job order number
JORDWAR - Joint Ordnance Wargame
JPG - Jefferson Proving Ground
JRP - Joint Requirements Planning
JRTC – Joint Readiness Training Center
JSC - Joint Steering Committee
J-SIIDS - Joint Services Interior Intrusion Detection System
JSIMIS - Joint Service Insensitive Munitions Information System
JSLRMD - Joint Service Large Rocket Motor Demilitarization
JSLRMDO - Joint Service Large Rocket Motor Disposal Office
JSLRMDP - Joint Service Large Rocket Motor Demilitarization Program
JSOW - Joint Standoff Weapon
JSSC - Joint Service Safety Chief
JTMO - Joint Traffic Management Office
JUSMAG-K - Joint U.S. Military Advisory Group - Korea
JUXOCO – Joint UXO Coordination Office
JWARN - Joint Warning and Reporting Network

KCC - Knowledge Collaboration Center
KIRC - Kaho'olawe Island Reserve Commission
KM – Knowledge Management
KMR - Keaukaha Military Reservation/Kwajalein Missile Range
KOP - Kingsbury Ordnance Plant
KP – potassium perchlorate
KSAAP - Kansas Army Ammunition Plant

KSEA - Korean Scientists and Engineers Association

LAAAP - Louisiana Army Ammunition Plant
LAAF - Laguna Army Airfield
LAN - local area network
LANL - Los Alamos National Laboratory
LAP - load, assemble, and pack
LAR - Logistics Assistance Representative
LASW - Lead Azide Sludge Waste
LAW - Light Antiarmor Weapon
LB/TS - Large Blast/Thermal Simulator
LC - Library of Congress
LC-94 - Launch Complex-94
LCA - life-cycle assessment/Logistics Control Activity
LCAAP - Lake City Army Ammunition Plant
LCC - life cycle cost
LCD - local climatologic data
LCDR - Lieutenant Commander
LCL - less-than-carload
LDR - land disposal restrictions
LDSP - land disposal site plan
LEA - U.S. Army Logistics Evaluation Agency
LEAD - Leadership and Development/Letterkenny Army Depot
LEDC - Logistics Executive Development Course
LEF - Leadership Effectiveness Framework
LHAAP - Longhorn Army Ammunition Plant
LIA - U.S. Army Logistics Integration Agency
LLM – Loader Launcher Module
LLNL - Lawrence Livermore National Laboratory
LMDC - Logistic Management Development Course
LMDF – Labor Master Data File
LMF - Labor Master File
LMI - Logistics Management Institute
LMP – Logistics Modernization Program
LMRS - Loose Mine Restraint System
LMTV - Light Medium Tactical Vehicle
LN – Local National
LOA - Letter of Agreement
LODA - Leghorn Army Depot Activity
LOGRUN - Logistics Remote Users Network
LOGSA PSCC - Logistics Support Activity Packaging, Storage, and Containerization Center
LOGTECH - Logistics Technology
LOI - Letter of Instruction
LP - lesson plan/Lightning Protection/Liquid Propellant
LPO - Library Program Office

LPRS - Loose Projectile Restraint System
LPS - Lightning Protection System(s)
LRA - Local Reuse Authority
LRMD - Large Rocket Motor Demilitarization
LRP - load and roll pallet
LRTAO - Logistics Review and Technical Assistance Office
LSAAP - Lone Star Army Ammunition Plant
LSC - Linear Shaped Charge
LSE - Logistics Support Element
LSP - Lodging Success Program
LSRM - Large Solid Rocket Motor
LSSI - Limited Scope Surety Inspection
LTC - Lieutenant Colonel
LTG - Lieutenant General
LTIP - Lightning Technology Improvement Program
LTL - less-than-truckload
LTSF - Long-Term Storage Facility
LVS - Logistical Vehicle System

M&RA - Manpower & Reserve Affairs
MAB - Missile Assembly Building
MABS - Military Application of Blast Symposium
MAC - Management Advisory Council/Military Airlift Command
MACS - Modular Artillery Charge System/Munitions Analysis Compliance System
MACT - Maximum Achievable Control Technology
MACOM - major Army command
MAJ - Major
MAMC - Madigan Army Medical Center
M&RA – Manpower and Reserve Affairs
MARC - machine readable cataloging
MARCENT - U.S. Marine Corps, Central Command
MARCORSYSCOM - Marine Corps Systems Command
MARID - Mobile Ammunition Renovation Inspection and Demil
MARRS - Modular Aviation Resupply/Rearm System
MASA – Muldraugh Ammunition Storage Area
MASL - Military Articles and Services Listing
MATCAT - Material Category Structure
MC - Medical Corps
MCA - Military Construction, Army/Minor Construction Authorization
MCAAP - McAlester Army Ammunition Plant
MCAS - Marine Corps Air Station
MCB - Managing the Civilian Work Force to Budget
MCE - maximum credible event
MCL – mission configured load
MCN - Management Control Number
MCPL - Master Corporal

MCPM - Major Army Career Program Manager
MCTSSA - Marine Corps Tactical Systems Support Activity
MCX - Mandatory Center of Expertise
MDA - Maintenance and Demilitarization Activity
MDARS - Mobile Detection Assessment Response System
MDC - magazine data card
MDEP - Management Decision Package
MDI - modernized demolition initiator
MDW - Military District Washington
MEC - Munitions and Explosives of Concern
MEDALS - Military Engineering Data Asset Locator System
MEDDAC - Medical Department Activity
MEMS – micro electronic mechanical sensors
MERIT - Mission Environmental Requirements Integration Technology
MFO – Multinational Force and Observers
MFP - Materiel Fielding Plan
MG - Major General
MGW - maximum gross weight
MHE - material handling equipment
MI – Minority Institutions
MICLIC - Mine Clearing Line Charge
MICOM - U.S. Army Missile Command
MIDAS - Munitions Items Disposition Action System
MIDP - Missile Distribution Program
MIF - Malfunction Investigation File
MILVAN - military van
MINICAM – miniature chemical agent monitor
MINS – Missile Information Notices
MIP - Monitoring Implementation Plan
MIPR - Military Interdepartmental Purchase Request
MIS - Market Impact Study
MITLA - Microcircuit Technology in Logistics Applications
MLAAP - Milan Army Ammunition Plant
MLB - Marine Logistics Base
M/LPA - Missile/Launch Pod Assembly
MLRS - Multiple Launch Rocket System
MLRS-ER – Multiple Launch Rocket System – Extended Range
MLW – Military Librarian Workshop
MM – Material Master
MMA – Main Missile Assemblages
MMD - Munitions Management Device
MMD-1 – Munitions Management Device, Version 1
MMR - Massachusetts Military Reservation/Military Munitions Rule
MMR2 – Military Munitions Rule II
MMSS - Munitions Management System Subgroup
MND - Ministry of National Defense

MNPF - Multinational Peacekeeping Force
MNS - Mission Need Statement
MOA - Memorandum of Agreement
MOADS - Maneuver Oriented Ammunition Distribution System
MOC - Management of Change
MOD - Ministry of Defense
MODS - Mobile Ordnance Destruction System
MOFA – Multi-Option Fuze for Artillery
MOFB– miniature open–front barricade
MOI – Memorandum of Instruction
MOPMS - Modular Pack Mine System
MOS - Military Occupational Specialty
MOTSU - Military Ocean Terminal, Sunny Point
MOU - Memorandum of Understanding
MOW - Model on a Wire
MPPEH – Material that Potentially Presents an Explosives Hazard
MPR - multipurpose range
MPRC – Multi-Purpose Range Complex
MPRC-H - Multi-Purpose Range Complex – Heavy
MR – Munitions Rule
MR2 – Munitions Rule 2
MRC – Missile Recycle Center/Multiple Round Container
MRIC - Munitions Rule Implementation Council
MRICD - Medical Research Institute of Chemical Defense
MRIP - Munitions Rule Implementation Policy
MRO - materiel release order
MRP - missile round pallet
MSAAP - Mississippi Army Ammunition Plant
MSB – missile storage building
MSC - major subordinate command/Military Sealift Command
MSD - minimum safe distance
MSDPF – Molten Salt Destruction Process Facility
MSDS - Material Safety Data Statement
MSEL - master scenario events list
MSESC - Military Services Explosives Safety Council
MSHA - Mine Safety and Health Administration
MSIC - Missile and Space Intelligence Center
MSM - Munitions Storage Module/Munitions Systems Management
MSO - molten salt oxidation
MSS - Modular Securement System
MST - Munitions Survivability Technology
MSTE - Modeling and Simulation of the Transportation Environment
MTA - Management and Technology Associates
MTF - Material Test Facility/mechanical time fuze
MTMC - Military Traffic Management Command
MTMCEA - Military Traffic Management Command - Eastern Area

MTMC-TEA - Military Traffic Management Command - Transportation Engineering Agency
MTS – Mustard Temperature Conditioning System
MTT - mobile training team
MTV - Medium Tactical Vehicle
MTV-LWB - Medium Tactical Vehicle-Long Wheel Base
MVAP - Munition Vulnerability Assessment Panel
MVO - Motor Vehicle Operator
MWG - Military Working Group/Munitions Working Group
MWO - Master Warrant Officer/modification work order

NA - non-availability
NAAF - Naval Auxiliary Airfield
NAAP - Newport Army Ammunition Plant
NAAS - Naval Auxiliary Air Station
NAMSA - NATO Maintenance and Supply Agency
NANP - North American Numbering Plan
NAPA - National Academy of Public Administration
NARA - National Archives and Records Administration
NARCL - Nuclear Accident Response Capability Listing
NAS - Naval Air Station
NASA - National Aeronautics and Space Administration
NATO - North Atlantic Treaty Organization
NAVEODTECHCEN - Naval Explosive Ordnance Disposal Technology Center
NAVFACENGCOM - Naval Facilities Engineering Command
NAVMAG - Naval Magazine
NAVORDCEN - Naval Ordnance Center
NAVSEA - Naval Sea Systems Command
NAVSTA - Naval Station
NAWC - Naval Air Warfare Center
NBC - nuclear, biological, chemical
NC – nitrocellulose
NCA - National Cemetery Administration
NCAD - New Cumberland Army Depot
NCBC - Naval Construction Battalion Center
NCCOSC - Naval Command Control and Ocean Surveillance Center
NCEL - Naval Civil Engineering Laboratory
NCES - National Center for Education Statistics
NCO - noncommissioned officer
NCR - National Capitol Region
NCSC - Naval Coastal Systems Center
NCTS-GC - Naval Computer and Telecommunications Station, Groupware Center
NDI - non-developmental initiative
NDIA – National Defense Industrial Association
NDT - Nondestructive Test
NDU - National Defense University

NEC - National Electrical Code
NECD - Newport Chemical Depot
NEL - Nevada Environmental Laboratories
NEPA - National Environmental Policy Act
NETSAFA - Naval Education and Training Security Assistance Field Activity
NEW - net explosives weight
NFESC - Naval Facilities Engineering Service Center
NFPA - National Fire Protection Association
NG - National Guard
NGB - National Guard Bureau
NGIC - National Ground Intelligence Center
NGTR - National Guard Target Range
NICP - National Inventory Control Point
NILS - Northern Illinois Library System
NIMIS - National Information Management Information System
NIOSH - National Institute of Occupational Safety and Health
NLLS - Navy Lessons Learned System
NLP - New Leader Program
NMD – National Missile Defense
NMP - National Maintenance Point
NMT - New Mexico Tech
NOAA - National Oceanographic and Atmospheric Administration
NOC - Naval Ordnance Center
NOCLANTDIV - Naval Ordnance Center, Atlantic Division
NOCPACDIV - Naval Ordnance Center, Pacific Division
NOFA - no further action
NOP - Naval Ordnance Plant/Nebraska Ordnance Plant
NOS - Network Operating System/Not Otherwise Specified
NOSSA – Naval Ordnance Safety & Security Activity (Indian Head, MD)
NPR - National Performance Review
NPRC - National Personnel Records Center/Navy Personnel Records Center
NPW - net propellant weight
NRC - Nuclear Regulatory Commission
NRDEC - U.S. Army Natick Research, Development and Engineering Center
NRL - Naval Research Laboratory
NSA – National Security Agency/Nonstandard APE
NSC – National Safety Council/Naval Safety Center
NSCM - Non-Stockpile Chemical Materiel
NSCWM - non-stockpile chemical warfare materiel
NSN - national stock number
NSNMDR - National Stock Number Master Data Record
NSSC - Naval Sea Support Center
NSWC - Naval Surface Warfare Center
NTC - National Training Center
NTI - near-term initiative
NTIS - National Technical Information Service

NTS - Nevada Test Site
NTSB - National Transportation Safety Board
NTS-CA - Nevada Test Site - Contractor's Association
NUWC - Naval Undersea Warfare Center
NWS - National Weather Service/Naval Weapons Station

OA – Obligation Authority/on or about
OACISM - Office of the Assistant Chief of Staff for Information Management
OASA - Office of the Assistant Secretary of the Army
OBG - old burning ground
OB/OD - open burning/open detonation
OBOD - Operational Board of Directors
OCLC - On-line Computer Library Center
OCONUS – Outside the Continental United States
ODASA-ESOH - Office of the Deputy Assistant Secretary of the Army (Environment, Safety, and Occupational Health)
ODASAF – Office of Director of Army Safety
ODCSLOG - Office of the Deputy Chief of Staff for Logistics
ODDS – Ordnance Detection and Discrimination Study
ODEP - Office of the Director of Environmental Programs
ODS - Operation Desert Shield/Operation Desert Storm or Ozone Depleting Substances
OE - ordnance and explosives
OEES - Ogden Environmental and Energy Services
OEESC - Ordnance Executive Environmental Steering Committee
OEESCM – Operations and Environmental Executive Steering Committee for Munitions
OES - Office of Emergency Services
OESO - Ordnance Environmental Support Office
OEW - Ordnance and Explosives Waste
OIP – Organizational Inspection Program
OIS/FTOS - Ordnance Initiation System, Flight Termination Ordnance System
OJE - Operation Joint Endeavor
OJF – Operation Joint Forge
OJT – On-the-Job Training
OLE - Organizational Leadership for Executives
OLF - Outlying Landing Field
OMA - Operation and Maintenance, Army
OMB - Office of Management and Budget
OMC - Operations and Maintenance Contractor
OMS - Ordnance Management System
OMMCS – Ordnance, Missiles, and Munitions Center and School
ONC - On Site Container
ONE – Operation Noble Eagle
OPA - Other Procurement, Army
OPAC - online public access catalog
OPCW - Office for the Prohibition of Chemical Weapons

OPLAN - operation plan
OPM - Office of Personnel Management
OPNAV - Naval Operations
OPSEC - Operations Security
ORD - Operational Requirements Document
OREMS - Oak Ridge Evacuation Modeling System
ORM - Other Regulated Materials
ORNL - Oak Ridge National Laboratory
ORP - Ordnance Reclamation Program
ORSA - Operations Research Systems Analysis
ORT – Operational Review Team
OSC - On-Scene Commander/On-Scene Coordinator
OSCAR - Outside Cable and Rehabilitation
OSD - Office of the Secretary of Defense
OSEC – Ocean Systems Engineering Company
OSHA - Occupational Safety and Health Act
OSIA - On-site Inspection Agency
OSU – Oklahoma State University
OT – operational testing
OTA - Ordnance Transfer Assemblies
OTC - Oshkosh Truck Corporation
OU – Oklahoma University
OUSD - Office of the Under Secretary of Defense

P2-CTX - Pollution Prevention Center of Technical Exchange
PA - public affairs
PAA - Procurement of Ammunition, Army
PAC - patriot advanced capabilities
PA&E - Program Analysis & Evaluation
PACOM - Pacific Command
PAD - propellant actuated devices/Product Assurance Directorate/protective action decision
PADRE - Protective Action Dose Reduction Estimator
PAED - public access exclusion distance
PALS - prestaged ammunition loading system
PAM - Penetrator Augmented Munition
PAO - Public Affairs Officer
P&P - Preservation and Packaging
PAPR - powered air purifying respirators
PAR - protective action recommendation
PARDOS - Partial Dosage
PAS - Pollution Abatement System
PAT - process action team
PAZ - Protective Action Zone
PBA - Pine Bluff Arsenal
PBCA - Pine Bluff Chemical Activity

PBD - Program Budget Decision
PBG – Program Budget Guidance
PBMA - U.S. Army Production Base Modernization Activity
PBO - Property Book Officer
PBR - Precision Bombing Range
PBXN – Plastic-Bonded Molding Powder
PCD - Pueblo Chemical Depot
PCH&T - packaging, crating, handling, and transporting
PCO - procurement contracting officer
PCS - permanent change of station
PD – point detonating/position description/purchase description
PDB - Project Development Brochure
PDEA - Preliminary Draft Environmental Assessment
PDF - Page Definition Format
PDL - permanent duty location
PE - practical exercise/program element
PEAT - Plasma Energy Applied Technology
PEC - Professional Education Center
PEG - Program Evaluation Group
PEO-CS - Program Executive Office - Combat Support
PEP - propellants, explosives, and pyrotechnics
PERC - Pittsburgh Energy Research Center
PERSCOM - U.S. Total Army Personnel Command
PES - potential explosion site/Pacific Environmental Solutions
PETC - Pittsburgh Energy Technology Center
PFS - Pollution Filter System
PHA - preliminary hazards analysis
PHC - Patrick Harrison Constructors
PHETS - Permanent High Explosives Test Site
PHS&T - Packaging, Handling, Storage, and Transportation
PHSH - Propulsion Systems Hazards Subcommittee
PI - periodic inspection
PII - pre-issue inspection
PIN - Personal Identification Number
PINS - Portable Neutron Isotopic Spectoscopy
PLC - Programmable Logic Controller
PLM – Product Lifecycle Management
PLS - Palletized Loading System
PM - Project Manager/Program Manager/Provost Marshal/Product Manager
PMAP1 - Performance Measurement Analysis Package 1
PMCD - Program Manager for Chemical Demilitarization
PME - Personnel Management for Executives
PMFVS - Protective Mask Fit Validation System
PMNSCM - Project Manager for Non-Stockpile Chemical Materiel
PMO - Program/Project Management Office/Provost Marshal Office
PMS - Pilot Model Shop

PMSA - Product Manager for Small Arms
PMUAST - Program Manager for Underground Ammunition Storage Technologies
PODS - PlasmaArc Ordnance Demilitarization System
POI - program of instruction
POM - Program Objective Memorandum/preparation for overseas movement
POMFLANT - Polaris Missile Fleet Atlantic
POP - Performance Oriented Packaging/Proof of Principle
PORTEX - Portable Small Item Automatic Real Time X-Ray Examination System
POSH – Prevention of Sexual Harassment
PPE - personal protective equipment/preproduction engineering
PPOA – Pollution Prevention Opportunity Assessment
PPP - Priority Placement Program
PPQT - preproduction qualification tests
PRD – potential for recycling or disposition
PREPO - Prepositioned Ships Afloat
PRON - Procurement Request Order Number
PSAB – Prince Sultan Air Base
PSC - personnel support complex/physical security code
PSEMO - U.S. Army Physical Security Equipment Management Office
PSF – pounds per square foot/Presidio of San Francisco
PSHS - Propulsion Systems Hazards Subcommittee
psi – pounds per square inch
PSM - Personnel System Managers
PSN - Proper Shipping Name
PSP - prepositioned stockage point/prestock point/propellant stability program
PSS - Physical Security Survey/Protective Security Service
PSSB - Propellant Safety Surveillance Board
PTA - Pohakuloa Training Area
PTR - public traffic route
PUCD – Pueblo Chemical Depot
PUDA - Pueblo Depot Activity
PURE – Packaging/Unitization Re-engineering
PWD - Procurement Work Directive
PWG - Planning Working Group/Public Working Group

QA - quality assurance
QANET – Quality Assurance Network
QASAS - Quality Assurance Specialist (Ammunition Surveillance)
QC - quality control
QD - quantity distance
QDC - quantity distance class
QMAT - Quality Management Advisory Team
QRC - qualified recycling program

R3 – resource recovery and recycling
R3M - Range Rule Risk Assessment Model

RAAF - Redstone Army Airfield
RAB - Restoration Advisory Board
R&D - research and development
RAC - Resource Allocation Committee/risk assessment code
RADM - Rear Admiral
RAM – Reliability, Availability, & Maintainability
RAP - rocket-assisted projectile
RAPS - Retrieval and Processing System
RASA - Redstone Arsenal Support Activity
RBAAP - Riverbank Army Ammunition Plant
RBESC – Risk-Based Explosive Safety Criteria
RBESCT – Risk-Based Explosive Safety Criteria Team
RBLS - River Bend Library System
RCRA - Resource Conservation and Recovery Act
RCW - reinforced concrete wall
RCWM - recovered chemical warfare materiel
RDA - Research, Development, and Acquisition
RDD - required delivery date
RDECOM – US Army Development Research and Engineering Command
RDTE - research, development, test, and evaluation
REACH - RDTE Excess Ammunition Clearing House
rebar - reinforcing bar
REC - Record of Environmental Consideration/Regional Environmental Coordinator
REP - Radiological Emergency Preparedness
RF - radio frequency
RFAAP - Radford Army Ammunition Plant
RFID – radio frequency identification
RFP - request for proposal
RFS - Request for Service
RFTA - Reserve Forces Training Area
RI - receipt inspection
RIA - Rock Island Arsenal/Robotics Industry Association
RIBS – Rapid International Bracing System
RIC - Routing Identifier Code
RIF - reduction in force
RIM - Retrieval Interface Manager
RIT - Receipt and Issue Transaction
RITA - Relocation Income Tax Allowance
RMA - Rocky Mountain Arsenal/Resource Management Analysis
RMAT - Real Property Management Automation Tools
RMBCS - Rocky Mountain Bank Card System
RMEW - Resource Management Executive Workshop
RMIS - Risk Management Information System
RMO - Resource Management Office
RMSEL - Robotic Manufacturing Science and Engineering Laboratory
ROC - Required Operational Characteristics/RESHAPE Operations Center

ROD - Report of Discrepancy
ROK - Republic of Korea
RO-RO - roll-on roll-off
RONA – Royal Ordnance of North America
RP - red phosphorus
RPO - Radiological Protection Officer
RPRS - Redundant Parachute Release System
RRAD - Red River Army Depot
RRAPDS – Remote Readiness Asset Prognostic/Diagnostic System
RRB – Resource Review Board
RRDA – Resource, Recovery, and Disposition Account
RRGDMT - Range Rule Guidance Development Management Team
RRIS - Range Rule Implementation Strategy
RRMC – Red River Munitions Center
RRPR – reduced range practice rocket
RRS - Rapid Response System/Recovery and Remediation Safety
RRSC – Range Response Subcommittee
RSA - Reserve Storage Activity/Redstone Arsenal
RSC - Regional Service Center
RSF - Residual Storage Facility
RSIC - Redstone Scientific Information Center
RSLP - Rocket Systems Launch Program
RSM - Resource Staff Member
RSNF - Royal Saudi Naval Forces
RSPA – Research and Special Program Administration
RSS - Remote Stuffing Site
RST - Re-Supply Trailer
RSV - Re-Supply Vehicles
RTAG - Range Technical Advisory Group
RTAP - Real-Time Analytical Platforms
RTCH - rough terrain container handler
RTR – Range Transfer Report
RTTC - Redstone Technical Test Center
RVAAP - Ravenna Army Ammunition Plant
RWG - Requirements Working Group

SA - small arms/Secretary of the Army
SAA - small arms ammunition
S&A - safety and arming
S&I – Substitutability and Interchangeability
S&T - Science and Technology
SAAS - Standard Army Ammunition System
SAASMOD - Standard Army Ammunition System Modernization
SABRE – Simplot Anaerobic Biological Remediation
SAC - Strategic Air Command
SACC - Strategic Arms Control and Compliance

SADARM - sense and destroy armor
SAEDA - Subversion and Espionage Directed Against the U.S. Army
SAF - Sample Analysis Facility
SAFER – Safety Assessment for Explosives Risk
SAIC - Science Applications International Corporation
SALWG - Senior Ammunition Logistics Working Group
SAMS - support agreement management system
SAN - Security Assistance Network
SAP – Systems, Applications, Products in Data Processing/Special Access Program/Systems Applications Products
SAPAS – Standard Army Procurement Accounting System
SARDA - Secretary of the Army for Research, Development and Acquisition
SATFA – Security Assistance Training Field Activity
SATO - Scheduled Airline Traffic Office
SAV - staff assistance visit
SAW – Strategic Army Workforce
SBCCOM – Solider and Biological Chemical Command
SBCT – Stryker Brigade Combat Team
SBIR - Small Business Innovative Research
SBIS - Sustaining Base Information Systems
SBT - Sustaining Base Training
SCA - small caliber ammunition SCAAP - Scranton Army Ammunition Plant
SCANS – Single Chemical Agent Identification Set (CAIS) Access and Neutralization System
SCBA - self-contained breathing apparatus
SCBCOM - Soldier and Chemical Biological Command (now SBCCOM)
SCEP – Student Career Experience Program
SCFR - supercritical fluid recovery
SCG - storage compatibility group
SCL - strategic configured load
SCM - Security Consultative Meeting
SCR - system change request/Senior Command Representative
SCS - Security Construction Statement
SCSI - Small Computer Systems Interface
SCWM - stockpile chemical warfare materiel
SCWO - supercritical water oxidation
SDA – Small Disposal Area
SDO - Supply Depot Operations
SDS - Standard Depot System
SDTF - Standard Data Task Force
SDW - substantial dividing wall
SECDEF - Secretary of Defense
SEDA - Seneca Army Depot Activity
SEEP - Scientist and Engineer Exchange Program
SEL - School of Engineering and Logistics
SERDP - Strategic Environmental Research and Development Program

SERPP – Surplus Energetics Reprocessing Pilot Plant
SES - Senior Executive Service
SETAF - Southern European Task Force
SEW – Safety Exemptions and Waivers
SFAAP - Sunflower Army Ammunition Plant
SFC - Sergeant First Class
SGM - Sergeant Major
SI - site inspection/site investigation
SIAD - Sierra Army Depot
SIMA - Systems Integration and Management Activity
SIRE - surveillance, inert storage and ammunition return center
SJON - Somards Job Order Number
SKA - skills, knowledge and abilities
SKAP - skills, knowledge, abilities, and personal characteristics
SLA - Service Level Agreement/Strategic Logistics Agency
SLAM - Selectable Lightweight Activated Munition
SLAP - Sabotaged Light Armor Penetrator
SLAPS - Standardized Laboratory Analytical Procedures
SLEP - Service Life Extension Program
SLP - Separate Loading Projectile
SLPC - Separate Loading Propelling Charge
SM – service member
SM1 – Standard Missile Type 1
SMAW - Shoulder-Launched Multi-Purpose Assault Weapon
SMAW-D – Shoulder-Launched Multi-Purpose Assault Weapon - Disposable
SMC - Space and Missile Center
SMCA - Single Manager for Conventional Ammunition
SMCO - Standard Missile Company
SMD - Surveillance of Maintenance Demilitarization
SMDR - Structure Manning Decision Review
SME - subject matter expert
SMEDP - Senior Managers Executive Development Program
SMI - Storage Monitoring Inspection
SMR - Surety Management Review
SN-CIE - Statement of Need - Clothing and Individual Equipment
SNL - Sandia National Laboratory
SOAR - Specific Operation Assistance Review
SOCC - Senior Officer Chemical Course
SOCCENT - Special Operations Command Center
SOCOM – U.S. Army Special Operation Command
SOG - Stockpile Operations Group
SOHFP - Safety, Occupational Health and Fire Protection
SOLIC – Special Operations and Low Intensity Conflict
SOMARDS - Standard Operations and Maintenance Army Research and Development System
SORI - Southern Research Institute

SOTF - U.S. Army Security Operations Training Facility
SOW - statement of work/scope of work
SPAL - Simulator, Projectile Airburst Liquid
SPAR - Safety Program Assistance Review
SPC - Statistical Process Control
SPCC - Ship Parts Control Center - (now IMSD)
SPEI - Solid Propellant Environmental Issue
SPG - Southwestern Proving Ground
SPI - special packaging instructions
SQL - Structured Query Language
SR - short range/site report
SRAM - Short Range Attack Missile
SRC - Single Round Container
SRCX - Single Round Container (Large)
SRF - Service Response Force
SRFC - Service Response Force Commander
SRFX - Service Response Force Exercise
SRIB - Structures Response to Impact and Blast
SRM - Solid Rocket Motor
SRP – Stockpile Reliability Program
SSA - Security Support Activity/supply support activity
SSC - Secondary Steel Container
SSCC - Site Security Control Center
SSD - Safety, Security, and Dismantlement
SSEB - Source Selection Evaluation Board
SSES - Supporting Studies for Explosives Safety
SSHP - Site Safety and Health Plan
SSP - safety site plan/Strategic Systems Programs
SSS – site safety submission
SSSC - self-service supply center
SST - Safe Secure Trailer
SSWAP - Safety, Security and Wellness Awareness Program
SSWG - System Safety Working Group
STAC - Special Technical Ammunition Course
STAF - Simulation/Test Acceptance Facility
STAFF - Smart Target Activated Fire and Forget
STANAG - Standardization Agreement
START - Strategic Arms Reduction Talks
STEPO - Self-Contained Toxic Environment Protective Outfit
STILAS - Scientific and Technical Information Library Automation System
STO – Science and Technology Objective
STON - short ton
STRICOM - U.S. Army Simulation, Training and Instrumentation Command
STS - Shipboard Transportation Simulator
SUS - Signal, Underwater Sound
SVDA - Savanna Army Depot Activity

SWA - Southwest Asia
SWPG - Southwest Proving Ground
SwRI - Southwest Research Institute

TAA – Total Army Analysis
TAAF - Tipton Army Airfield
TAB – Thumrait Air Base
TAC - Technical Advisory Committee/Technical Ammunition Course
TA/CE - Technical Assessment and Cost Estimate
TACITS - Total Army Centralized Individual Training Solicitation
TACMIS - Tactical Management Information System
TACMS - Tactical Missile System
TACOM - U.S. Army Tank-automotive and Armaments Command
TAD - Transatlantic Division
TaDD – Tactical Demilitarization Development
TAG - Technical Advisory Group
TAIL – TACOM Integrated Armor Laboratory
TALPRS - Time, Attendance, Labor and Productivity Reporting System
TAMIS - Training Ammunition Management Information System
TAMMC - Theater Army Materiel Management Center
TAP - Toxicological Agent Protective
TAPES - Total Army Performance Evaluation System
TAQ - Total Army Quality
TARDEC - Tank-Automotive Research, Development and Engineering Center
TAV - Technical Assistance Visit/Total Asset Visibility
TBI - Through Bulkhead Initiator
TC94 - TURBO CADS 94
TC94 - TURBO CADS 94
TC95 - TURBO CADS 95
TC97 - TURBO CADS 97
TC99 – TURBO CADS 99
TC00 – TURBO CADS 00
TCAAP - Twin Cities Army Ammunition Plant
TCAT – Toxic Chemical Agent Team
TCC - telecommunications center
TCCH - toxic chemical change house
TCE - trichloroethylene
TCF - Treaty Compliance Facility
TCG III – Technology Coordination Group III
TCG IX - Technology Coordination Group IX
TCM - toxic chemical munitions
TCMF - toxic chemical maintenance facility
TCRA - Time Critical Removal Action
TCRI -
TCSM - Technical Chemical Surety Materiel
TCU - temperature conditioning unit

TDA - tables of distribution and allowances
TDCMS - Technical Data Configuration Management System
TDL - tunable diode laser
TDP - technical data package
TDR - Technical Data Repository/transportation discrepancy report
TEAD - Tooele Army Depot
TECOM - U.S. Army Test and Evaluation Command **(now DTC)**
TEGDN - triethylene glycol dinitrate
TEMP - Test and Evaluation Master Plan
TEP - Technical Evaluation Panel
TEU - U.S. Army Technical Escort Unit
TEXCOM - U.S. Army Test and Experimentation Command
TFE - Technology Feasibility Evaluation/Task Force Eagle
TFF - Task Force Falcon
THAAD - Theater High Altitude Air Defense
THAADS - Theater High Altitude Air Defense System
TIAMS - TECOM Integrated Ammunition Management System
TIPA - Treaty Implementation for Panama
TIM – Transformation of Installation Management
TIWG - Test Integration Working Group
TLC - Thin Layer Chromatography
TM – Technical Manual
TMDE - test, measurement, and diagnostic equipment
TMETN - trimethylolethane trinitrate
TNGSPTCEN - U.S. Army Training Support Center
TNT - trinitrotoluene
TOCD - Tooele Chemical Depot
TOCDF - Tooele Chemical Agent Disposal Facility
TOF - transfer of function
TOFC - trailer-on-flatcar
TOR - Terms of Reference
TPDS-T - Target Practice Discarding Sabot with Tracer
TPE - Technical Planning and Evaluation
TPS - transportation protective service
TPT – Target Practice w/Tracer
TQSE – Temporary Quarters Subsistence Expense
TRAC – TRADOC Analysis Center
TRADOC - U.S. Army Training and Doctrine Command
TRADOC-MSM - U.S. Army Training and Doctrine Command - Munitions System Manager
TRANSCOM - U.S. Transportation Command
TRAP - Training Resources Arbitration Panel
TRAVISS - Training and Visual Information Support System
TRI - Toxic Release Inventory
TSC – Theater Support Command
TSM - TRADOC System Manager

TSP - Technical Support Plan/thrift savings plan
TSSAM - Tri-Service Standoff Attack Missile
TSSCA - Third Stage Separation Charge Assembly
TTF - Transportability Test Facility
TTP - Technology Transfer Plan/Total Training Packages
TTT - Train-the-Trainer
TTU - thermal treatment unit
TTX - Tabletop Exercise
TUSA - Third U.S. Army
TVA - Tennessee Valley Authority
TWG - Technical Working Group
TYAD - Tobyhanna Army Depot

UAE - United Arab Emirates
UAPB - University of Arkansas-Pine Bluff
UARC – University Applied Research Center
UAV - Unmanned Aerial Vehicle
UBL - unit basic load
UFR - unfinanced requirement
UFTR - Universal Function Test Range
UGS/AHWG - Underground Storage/Ad Hoc Working Group
UIT – Unique Item Tracking
ULO - Unliquidated Obligation
UMC - Unit Movement Coordinators
UMI - University Microfilm Incorporated
UMCD - Umatilla Chemical Depot
UMCDF - Umatilla Chemical Agent Disposal Facility
UMDA - Umatilla Depot Activity
UMTU - Unserviceable Munitions Treatment Unit
UN - United Nations
UNMIH - United Nations Mission in Haiti
UOFSA - UXO-Contaminated Land Management Functional Subactivity/Unexploded Ordnance Functional Subactivity
UPS - Uninterrupted Power Supplies
URC - Unclassified Reference Center
USAADA - U.S. Army Ammunition Depot, Akizuki
USAADASCH - U.S. Army Air Defense Artillery School
USAARMC - U.S. Army Armor Center and Fort Knox
USACAP - U.S. Army Chemical Activity, Pacific
USACDRA - U.S. Army Chemical Demilitarization and Remediation Agency
USACE - U.S. Army Corps of Engineers
USACMDA - U.S. Army Chemical Materiel Destruction Agency
USACMLS - U.S. Army Chemical School
USACOM - EST used in 13 May 96 staff notes!
USACHPPM - U.S. Army Center for Health Promotion and Preventative Medicine
USACSTA - U.S. Army Combat Systems Test Activity

USAEDH - U.S. Army Engineering Division, Huntsville
USAESCH - U.S. Army Engineering and Support Center, Huntsville
USAEWES - U.S. Army Engineer Waterways Experiment Station
USAF - U.S. Air Force
USAFAC - U.S. Army Field Artillery Center and Fort Sill
USAFE - U.S. Air Forces in Europe
USAFSTC - U.S. Army Foreign Science and Technology Center
USAG - U.S. Army Garrison
USAINSCOM - U.S. Army Intelligence and Security Command
USAISC-AMCCOM - U.S. Army Information Systems Command - AMCCOM
USAISEC - U.S. Army Information Systems Engineering Command
USAKA - U.S. Army Kwajalein Atoll
USAMCLS - U.S. Army Military Police and Chemical School-check out!
USANCA - U.S. Army Nuclear and Chemical Agency
USAOMMCS - U.S. Army Ordnance Missile and Munitions Center and School
USAPPC - U.S. Army Printing and Publications Command
USAR - U.S. Army Reserve
USARAK - U.S. Army, Alaska
USARC - U.S. Army Reserve Command
USAREUR - U.S. Army, Europe
USARJ - U.S. Army, Japan
USARPAC - U.S. Army, Pacific
USARSO - U.S. Army, South
USARSPACE - U.S. Army Space Command
USASAC - U.S. Army Security Assistance Command
USASC - U.S. Army Safety Center
USASC&FG - U.S. Army Signal Center and Fort Gordon
USASCH - U.S. Army Support Command, Hawaii
USASMDC – U.S. Army Space and Missile Defense Command
USASOC - U.S. Army Special Operations Command
USASSDC – U.S. Army Space and Strategic Defense Command – now USASMDC
USASSC – U.S. Army Soldier Systems Center
USATCES - U.S. Army Technical Center for Explosives Safety
USATSCH - U.S. Army Transportation School
USCG - U.S. Coast Guard
USDA - U.S. Department of Agriculture
USFK - U.S. Forces, Korea
USGS - U.S. Geological Survey
USMA - U.S. Military Academy
USMC - U.S. Marine Corps
USN - U.S. Navy
USPACOM - U.S. Pacific Command
USPFO - U.S. Property and Fiscal Office
UT – University of Texas
UTTR - Utah Test and Training Range
UV - ultraviolet

UWARS - Universal Water Activated Release System
UXM - unexploded ordnance module
UXO - unexploded ordnance
UXO(C) – unexploded ordnance and other constituents

VADS - Vulcan Air Defense System
VCEP - Value Engineering Change Proposal
VCR - Vapor Containment Room
VCS - vapor containment structure
VCSA - Vice Chief of Staff, U.S. Army
VEM - Validation, Establishment, or Modification
VENUS - video enhanced user system
VERA - Voluntary Early Retirement Authority
VI - visual information
VISTA - Visibility Information Storage Tool for Ammunition
VLA - Vertical Launch ASROC/Very Large Array
VRA - Veteran's Readjustment Appointment
VRRTFLT - variable reach rough terrain forklift
VSIP - Voluntary Separation Incentive Pay
VTC - video teleconference
VTF - Vibration Test Facilities

WAAF - Wheeler Army Airfield
WADF - Western Area Demilitarization Facility
WAIS - Wide Area Information Service
WAM - Wide Area Mine/Wide Area Munitions
WAMS – Wide Area Mines System
WAN - Wide Area Network
WAP – Waste Analysis Plan
WARS - Worldwide Ammunition Reporting System
WASP - Wholesale Ammunition Stockpile Program
WBT - web-based training
WC50 - West Center 50
WDTC - West Desert Test Center
WGA - Western Governors' Association
WIC - Workload Indicator Code
WMD - weapons of mass destruction
WMDC – Western Management Development Center
WO - Warrant Officer
WP - white phosphorous
WPA – Works Progress Administration
WPAFB - Wright-Patterson Air Force Base
WP-PAC – White Phosphorous to Phosphoric Acid Conversion Plant
WRS-T - War Reserves Stocks - Thailand
WSA - Weilerbach Storage Area
WSC - Waste Stream Characterization

WSMD - Weapons System Management Directorate
WSMR - White Sands Missile Range
WSOW - Weldon Springs Ordnance Works
WTA - Wildflecken Training Area
WUIS - Work Unit Information System
WVA - Watervliet Arsenal
WWPS - Worldwide Port Study
WWW - Worldwide Web

YPG - Yuma Proving Ground
YTC - Yakima Training Center