Agenda

- Project Genesis
- FDHS Design and Production
- FDHS Installation on Cape Ray
- Destruction of Syrian CWM
- Return and Decommissioning of Cape Ray
FDHS Project Timeline

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12/27

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Capabilities Assessment

- Capabilities Assessment requested by Threat Reduction Advisory Committee (TRAC) on December 27, 2012

- Identify technologies that are currently available, or could be available within 6-12 months, capable of:
  - Destroying bulk liquid chemical agent or precursors
  - Operating in a remote location
  - Operating in semi-permissive or uncertain environment

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• 28 Jan 2013: ECBC and JPM-E directed to demonstrate a suitable technology by 31 Jul

• Neutralization (hydrolysis) was selected as the only technology that could be demonstrated in this time frame

\[ \text{PO} \text{CH}_3 \text{F} + \text{H}_2\text{O} \rightarrow \text{PO} \text{CH}_3 \text{OH} + \text{H}_2\text{O} \]

• 15 Feb 2013: Scope and schedule changes:
  • Required to produce and demonstrate a full deployable capability
  • Deadline moved to 1 Jul 2013
### FDHS Project Timeline

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Design/Production Team

CBARR
- ECBC chem/bio operations division
- Overall project management responsibility
- Assembled reactor and hydrolysis skids and other components

JPM-E
- JPEO-CBD CW elimination experts
- Co-designers with ECBC
- Funded second and third FDHS prototypes

ADM
- ECBC rapid-prototyping unit
- Computer-aided drafting, simulation support, and fabrication of parts

ECBC R&T
- ECBC’s research and technology directorate
- Bench-scale chemistry and analysis of waste

DTRA
- CBDP R&T funding organization
- Funded first FDHS prototype

ACC
- Edgewood branch of Army Contracting Command
- Dedicated Contracting Officer support

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Requirements

- Destroy bulk liquids in metric ton quantities
- Destroy HD, DF, possibly other precursor compounds
- Achieve 99.9% destruction efficiency
- Achieve throughput rate of at least 3 MT/day
- Operate 24 hours/day, 7 days/week
- Be transportable by standard modes of transportation
- Operate at remote sites
- Be operable within 10 days of equipment arriving on site

Binary Destruction Facility (BDF) managed by CMA/NSCMP destroyed 127 tons of DF from 2003-2006

Aberdeen Chemical Agent Disposal Facility (ABCDF) managed by CMA destroyed 1,621 tons of HD from 2003-2005

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### Basis of Design

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Characteristics</th>
<th>Achieved By</th>
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<tr>
<td>Destruction/Throughput</td>
<td>• Reliance on proven technology</td>
<td>• Basing process flow and chemistry on ABCDF</td>
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<td>• Process flexibility</td>
<td>• Using 2 surplus reactor vessels from ABCDF</td>
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<td>• Designing for varying recipes and flow rates</td>
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<td>• Using chemical-resistant materials of construction</td>
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<tr>
<td>Transportability</td>
<td>• Modular design</td>
<td>• Designing system to fit within 20’ ISO frames</td>
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<td>• Selecting ancillary systems that fit within 20’ ISO containers</td>
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<tr>
<td>Remote Location</td>
<td>• High availability</td>
<td>• Installing redundant components</td>
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<td>• Operator-level maintenance</td>
<td>• Using flanged connections</td>
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<td></td>
<td>• Self-sufficiency</td>
<td>• Procuring generators and water heaters</td>
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<td>• Designing custom electrical and air distribution systems</td>
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<tr>
<td>10-Day Setup/Systemization</td>
<td>• “Plug-and-play” setup</td>
<td>• Designing transport configuration to be very similar to operational configuration</td>
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<td>• Simplicity</td>
<td>• Quick disconnects and easy-to-install flexible connections between components</td>
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<td>• Color-coding and component labeling</td>
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Primary Skid Design

CAD modeling of primary skids by ADM (March 2013)

Reactor Skid

Hydrolysis Skid
Modular System Design with FDHS Technology

Field Deployable Hydrolysis System Site Layout

Legend
1 Breathing Air Compressor  7 System Air Compressors
2 Personnel Decon Station  8 Waste Containers
3 CAFS  9 Reagents
4 Hydrolysis System  10 Water Heater & Power Distribution
5 Water Pump  11 Lab
6 Water Tank  12 Generators

(Not Pictured)
Storage/Supply Containers

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## FDHS Project Timeline

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Transition and Planning

- FDHS technology transferred from DTRA to JPEO on June 27, 2013
- Concept of Operations planning
  - 6 systems deployed at 2 or 3 sites in country
  - Tabletop exercises
  - Materiel release for active duty operators
- Capability demonstration and validation conducted September 16-22, 2013
- 7 FDHS systems procured/fabricated through May 2014
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FDHS Project Timeline

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August 21, 2013
Sarin (GB) attacks on Ghouta

- Estimates range from a few hundred to over 1,000 deaths
- Assad regime accused of orchestrating attack

September 14, 2013
Syria agrees to turn over CW Stockpile

- Syria to sign Chemical Weapons Convention
- All CWM to be destroyed by June 30, 2014
Cape Ray Decision

- Possibility of ship-based destruction raised by JPEO/ECBC/DTRA, with two FDHS platforms on board
  - Provides ample water supply
  - Provides security
- Design team visited ships in September 2013 in Baltimore and Portsmouth
- No countries volunteered to accept Syrian CW for destruction
- Cape Ray, part of the Maritime Administration’s Ready Reserve Fleet, selected for mission in November 2013
FDHS Installation Team

- FDHS design and production team
- Installed equipment on Cape Ray
- Analyzed sea state effects on system integrity

MARAD

- DOT organization that runs the Ready Reserve Fleet
- Coordinated all modifications to Cape Ray

DTRA

- Organization that runs the Cooperative Threat Reduction (CTR) program
- Provided funding and planning support

Keystone

- Contractor that operates the Cape Ray
- Assisted in installation
- Integrated all on-board installations

- DoD approval authorities
- Guided installation process and issued approvals for operation

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Maritime Ops Challenges

- Problem: Loading and storing all equipment and material on Cape Ray
  - 269 total ISO containers (6,000 gal each) on board
  - 78 shipping containers full of Syrian CW
  - Very limited capability for transfer of equipment within and to/from Cape Ray
  - Distribution of loads changing daily during operations

- Approach
  - Collaboration on initial and predicted load planning with Keystone
  - Real-time adjustments to load plan throughout operations
  - pH adjustment system designed to allow safe long-term storage

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Maritime Ops Challenges

• Problem: Requirement to prevent agent liquid or vapor release to the environment

• Approach:
  – FDHS equipment and all Syrian CW stored on Main Trailer Deck
  – Only reagent and effluent pass between decks – no agent
  – Existing ventilation system retrofitted with carbon filtration
  – Multiple levels of environmental controls:
    – Reaction occurs in closed system of FDHS
    – FDHS located within ventilated environmental enclosure (EE)
    – EE located within Main Trailer Deck with ventilation/filtration system

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Maritime Ops Challenges

- Problem: Ship environment imposes unusual forces on equipment
  - Vibration effects of ship’s propeller
  - Forces in multiple directions caused by ship movement, “sloshing” of liquid

- Approach:
  - ADM, AMSAA, and Navy personnel performed analysis
  - Additional bracing installed for primary FDHS skids and holding tanks
  - Ship roll/pitch limits implemented to halt operations in worst conditions
Maritime Ops Challenges

- **Problem:** Movement of Syrian DF tanks
  - Weight of tanks over 8,000 lbs each
  - Aisle space between containers and FDHS equipment ~ 8 feet (severely limits forklift movement)

- **Approach:**
  - Container movement system developed by CBARR and ADM engineers/operators
  - Allowed for movement of containers without personnel inside shipping container or in path of movement
  - Positive control maintained on front and rear side of tank, mitigating effects of ship movement
  - Minimized risk of spill or injury

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<td>Cape Ray Departure</td>
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UN/OPCW Joint Mission

Mission Leadership

- Operate FDHS and Cape Ray
- Provide Port for Transload
- Destroy V-series Precursors
- HD Waste Disposal
- Accept CWM at Latakia
- Facilities Contracted for Industrial Chemical and DF Waste Disposal
- Security Support

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<table>
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<th><strong>NAVEUR</strong></th>
<th><strong>Keystone</strong></th>
<th><strong>Parsons</strong></th>
<th><strong>OPCW</strong></th>
<th><strong>DTRA</strong></th>
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<tr>
<td>US Naval forces Europe (subordinate to EUCOM)</td>
<td>Contractor that operates the Cape Ray</td>
<td>Contractor for DTRA’s CTR program</td>
<td>Organization charged with enforcing CWC</td>
<td>Organization that runs the CTR program</td>
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<td>Overall mission responsibility</td>
<td>Contractor provided oversight of all chemical ops</td>
<td>Provided non-agent operational support to FDHS ops team</td>
<td>Observed agent operations and certified CWC operations</td>
<td>Funded all Cape Ray operations</td>
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- FDHS Operational Team
- Conducted agent ops and provided oversight of all chemical ops
- Standard ship management functions

- Organization charged with enforcing CWC
- Funded all Cape Ray operations

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Concept of Operations

- 100% inspection of Syrian containers
- Concurrent DF operations in both systems
- HD operations in one system
- 24/7 operations
- Ramp-up to full throughput and shift work
Operational Challenges

- Buildup of solids in pH adjustment tanks
- High temperatures in work area
- Effluent management and near-real-time load plan adjustments
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1QFY14
- Receipt of Syrian CW
2QFY14
- Destruction Complete
3QFY14
4QFY14
1QFY15
2QFY15

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Mission Success

- Agent operations started July 7, 2014
- Agent operations completed August 17, 2014
- 580 MT of DF and 20 MT of HD destroyed in 42 days
- Offloading of waste completed September 5, 2014
- Cape Ray return to Portsmouth September 17, 2014
- Cape Ray operations area cleared of DF/HD January 14, 2015

Next Steps:
- All FDHS equipment stored at APG-EA awaiting future use
- Cape Ray to be returned to Ready Reserve Fleet

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The success of the FDHS and the Cape Ray in the destruction of the Syrian chemical weapons stockpile was made possible by the collaboration of many government and contractor organizations with varied expertise, accomplishing remarkable things in extraordinarily short timeframes.