Destruction of Old Chemical Bombs using DAVINCH™ at Kanda, Japan

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Operations at Kanda
Chemical Bombs from WW2 on the sea bed in Kanda Port

• Locate Suspicious OCWs
• Recovery of OCWs
• Destruction of OCWs
Location of Destruction Facility and Work Area

- Destruction Facility
- Work Area (approx. 1250 bombs)
- Kohnoshima Island
- Kanda Port
## Overall Schedule

<table>
<thead>
<tr>
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<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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<td>10 11 12</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
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<tr>
<td><strong>Contract</strong></td>
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<tr>
<td><strong>Construction</strong></td>
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<tr>
<td><strong>Destruction</strong></td>
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<td><strong>Contract</strong></td>
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<td><strong>Phase 1</strong></td>
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<td><strong>Phase 2</strong></td>
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<td><strong>Phase 3</strong></td>
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</tbody>
</table>

- Phase 1: 57 bombs
- Phase 2: 538 bombs
- Phase 3: 659 bombs
Old Chemical Bombs Destructed at Kanda, Japan

Phase 1 (2004)  57 bombs
Phase 2 (2005)  538 bombs
Phase 3 (2006)  659 bombs

Total 1,254 bombs
Old Chemical Weapons recovered from Kanda Port

50cm
10cm

Burster
Fuse
Booster
Chemical Agent

Identification belt

70cm
1m

20cm

50kg Yellow Bomb
(2.3kg of High Explosive, 18 L of CA)

15kg Red Bomb
(1.3kg of High Explosive, 368 g of CA)
Characteristics of Old Chemical Weapons recovered from Kanda Port

① Contain As,
② Heavily deteriorated, deformed and corroded,
③ Covered with shellfish

<table>
<thead>
<tr>
<th></th>
<th>Chemical Agent</th>
<th>Explosive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Bombs</td>
<td>Mustard + Lewisite</td>
<td>Picric Acid + TNT</td>
</tr>
<tr>
<td>Red Bombs</td>
<td>DA, DC (similar to Clark I, II)</td>
<td>Picric Acid + TNT</td>
</tr>
</tbody>
</table>
Work Procedure at Kanda

Work on and in the sea

- High Accuracy Magnetometer Detection
- Uncover
- Recovery
- Unloading Transportation

Work at the Facility

- Inspection and Identification
- Temporary Storage
- Preparation
- Destruction by Detonation
- Off-gas Treatment
Locate Suspicious OCWs

(High Accuracy Magnetometer Detection)

Magnetometer Detection Probe
Magnetic Anomaly Map
Tug Boat
FRP-composite Detection Boat
Data Recorder
Detection Operation
Uncovering / Recovery of OCWs

① Uncover objects

② Take X-rayed picture in the sea

③ Put into a cylinder

④ Recovery
Schematic Flow of Kanda Chemical Weapons Destruction Facility

- Identification
- Transportation
- Temporary Storage
- Destruction
- Off-gas Treatment

Detection → Kanda Port
Recovery → Munitions
Uncovering

DAVINCH™
Vacuum Pump
Combustion Furnace
Hold Tank
Charcoal
Drain

Fragments

To Conventional Waste Treatment Facility
DAVINCH™

Detonation of Ammunition in Vacuum Integrated Chamber

Structural Characteristics
• Double-Shelled Cylinders (Outer & Inner Cylinders)
• Multi-layered Outer Cylinder (Pressurized container)
• Removable Inner Cylinder (Can be replaced if it is damaged)

Operational Characteristics
• Detonation in Vacuum
• Sequential Detonation
• Emulsion explosive as donor charge
• Implosion Process

Performance Characteristic
• High-DRE only by detonation
Double walled structure with removable inner chamber

Inner chamber

Sacrificial chamber against fragments

Outer chamber

High-pressure vessel against impulsive pressure
Multi-layered Outer Chamber

Detection hole to monitor the leakage from the 1st layer

Carbon steel

Multiple-Layered Outer Chamber

Removable Inner Vessel
DAVINCH™ in operation

Remote Operation
Examination & Improvement

• Longer Chamber
• Minimize Amount of Explosives
• Improve Setting Method of Bombs
• Trace Arsenic Behavior
• Data acquisition of pressure, strain, composition of off-gas for further improvement
• Cleansing Shot
• Application of Cold Plasma
Cold Plasma

- Compact
- High efficiency burning
- Low power requirement
- Rapid start-up
Cold Plasma GildArc Operating Principle

Electrode A → gas → ignition

Electrode B → gas → expansion & work

Electrode C → gas → extinction
Thank you!

Hope we can be of service to you!!
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