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Subject: Request for Information, Technology for Camp Minden cleanup of M6 and CBI
Response to Follow-Up Questions from the EPA

Dear Mr. Sarno,

On March 4, 2015Clean Harbors and ECC presented our thermal oxidizer with feed preparation technology to the Minden Dialogue Committee. Using this alternative approach, we are confident that the Clean Harbors / ECC team can safely and efficiently perform the removal and destruction of 15,687,247 lb of M6 Propellant (M6) and 320,890 lb of Clean Burning Igniter (CBI) that is located in ninety seven storage igloos at the former Explo Systems Inc. Site located on Camp Minden, Louisiana.

On March 10, Clean Harbors received written follow-up questions from the EPA, via Doug Sarno. The questions and responses are presented below.

## Technology

1) Please provide a detailed description of your technology.

Clean Harbors / ECC Response 1: A Camp Minden specific process flow diagram is being finalized at this time and will be included in the proposal due March 18, 2015. In the meantime, we refer you to the CH-ECC presentation to the Dialogue Committee.

2) Please include a process flow diagram.

Clean Harbors / ECC Response 2: A Camp Minden specific process flow diagram is being finalized at this time and will be included in the proposal due March 18, 2015. In the meantime, we refer you to the CH-ECC presentation to the Dialogue Committee that included a simplified block flow diagram.

3) What are your utility needs (daily quantity)? (i.e., fuel, electricity, water, etc.)

Clean Harbors / ECC Response 3: The anticipated utility needs are:

- Water: ~ < 1200gal/h
- Electricity: ~ < 400KW
- Fuel: ~< 20 MMBtu/hr

4) Other than M6 and fuels, what quantity of other raw material or treatment material you will use (major materials only; no proprietary chemical information) in your treatment process.

Clean Harbors / ECC Response 4: The feed preparation may include the addition of sodium hydroxide to improve the feed characteristics. There are no other raw or treatment material consumed.

5) Any special needs required?

Clean Harbors / ECC Response 5: None beyond standard industry practices and safety protocols for this type of operation.

6) What are the controls in place to prevent an explosion, excessive heat, or uncontrolled reaction?

Clean Harbors / ECC Response 6: Detailed Safety and Work Plans will be developed, for approval, as part of the initial stages of the project. The Clean Harbors / ECC team possesses all the trained and qualified Munitions and UXO Specialists required to develop the Magazine Download Plan. Handling of the material will be minimized to the extent possible, and will be detailed in the Plan.

7) What pretreatment (i.e., grinding, slurry, etc.), if any, is required? Please provide a detailed description.

Clean Harbors / ECC Response 7: Pretreatment is integral to our process, for both efficiency of destruction and safety. We are confident our proposed pretreatment and process will accomplish both. These pretreatment details will be more clearly spelled out in our proposal submitted on March 18.

8) How will the propellant be handled prior to treatment?

Clean Harbors / ECC Response 8: As noted in response #6 above, the Clean Harbors / ECC team will deliver highly trained and qualified Munitions and UXO Specialists, who will develop a Magazine Download Plan as an initial submittal for approval prior to execution. This Plan will prioritize magazines, outline personnel exposure plans, and detail equipment and safety protocol for handling the propellant. Handling protocol will vary with the conditions encountered in each magazine.

9) Has this technology ever been approved by Department of Defense Explosive Safety Board for use at a site?

Clean Harbors / ECC Response 9: Yes. Our team has implemented this technology at another site, which was approved by DDESB. Additionally, our munitions operations, including Iraq and Afghanistan, have been under the direct supervision of USAECSH, with the required DDESB approved processes and site plans.

**Equipment**

1) Detailed description of each piece of equipment. This includes pollution control equipment.

Clean Harbors / ECC Response 1: As noted in our briefing, our process equipment for the thermal oxidizer will be readily available and off the shelf.

The equipment that will be employed for pretreatment has been designed to enhance the stability of the propellant prior to thermal destruction. The prepared propellant feed will be fired in refractory lined thermal oxidizer(s) with supplemental fuel (natural gas, propane or diesel) as required to maintain oxidizer temperatures at a nominal 1,600-1,800°F. After quenching, the flue gas will be treated in a baghouse to remove particulate matter before discharge to the atmosphere.

The air pollution control system will consist of a water quench to reduce exhaust gas temperatures. It is not designed to remove specific contaminants. Following the water quench, exhaust gases will be passed through a bag house filter to remove particulates. All quench water will be evaporated and discharged through the bag house with the exhaust gases.

Chemical scrubbers can be added to the air pollution control train if required, but are not necessary to meet the emission criteria promulgated in the Applicable Relevant and Appropriate Requirements (ARARs). Additional air pollution control systems above the promulgated ARARs can be included as an optional cost if requested.

The equipment used to download the propellant from the magazines will be enhanced to meet the safety protocol as will be outlined in our Magazine Download Plan. Additional details will be outlined in our proposal, due March 18.

2) Describe Siting and footprint requirements. (i.e., distance between multiple units, etc.)

Clean Harbors / ECC Response 2: The key space requirements are dictated by the Net Explosive Weight Quantity Distances (QD) per DoD 6055.09-M-V5. The process area will entail approximately 1,400-ft by 1,400-ft even though the actual process equipment footprint will be significantly less at ~6,000 $ft^2$. It is anticipated that the thermal treatment operations will occur at Area E, and that the closest offsite residents are over 5,000 ft away, which meets the safety requirements of DoD 6055.09-M-V5. Distances between units will be detailed in our proposal and subsequent design details, but will be less than 1,000 feet depending on terrain and site layout restrictions/requirements.

The treatment system will require utility infrastructure (i.e. electrical power, potable water, sewerage for onsite personnel, natural gas or propane, and phone / internet if available). If phone / internet are not available, then we will provide cellular service to onsite personnel.

The treatment facility also will require modification to the existing civil infrastructure to create suitable concrete treatment pads for the equipment, and will require improvement to non-paved roads between the magazines and the treatment area as needed.

3) Any specialized equipment for handling/transporting and/or pretreating the propellant? Please describe.

Clean Harbors / ECC Response 3: Clean Harbors / ECC will use handling equipment that is common to the ammunition industry for magazine download and transportation operations. Certain types of this equipment has specialized exhaust controls with spark arrestors which allow them to operate inside ammunition magazines.

The equipment that will be employed for pretreatment has been designed to enhance the stability of the propellant prior to thermal destruction. Additional details will be outlined in our proposal, due March 18.

**Relevant Experience**

1) Please describe your direct experience in handling and treating bulk M6 Propellant. This description should include volumes, where, and was it a bench scale or full scale operation.

Clean Harbors / ECC Response 1: Please refer to the table below for details of our team's experience.

The proposed process has been used at up to 1,200 lbs/hr (dry basis) or approximately 8 MM Btu/Hr for waste M6 propellant from manufacturing operations. Destruction efficiencies of this full scale operation are greater than 99.9%. It is a reasonable scale factor to design the demonstrated process for the required Camp Minden throughput in order to be compliant with the timelines specified in the EPA UAO.

2) Please describe your experience in handling and treating bulk propellants similar to M6. This description should include volumes, where, and was it a bench scale or full scale operation.

Clean Harbors / ECC Response 2:

| **Location** | **Dates** | **Amount of Material** | **Type of Material** |
|---|---|---|---|
| Clean Harbors Colfax, LLC, Colfax, LA | 1993 - Ongoing | 561,700 lbs Annually | High explosives, munitions, propellants and related materials |
| Confidential Client, Camp Minden, LA | 2014 | 849,000 lbs | Nitrocellulose |
| Kosteny Rocket Base, Belarus, DSWA | 1998 | 5,000 tons | Heavy fuel oil, VOCs & PAHs |
| Iowa Army Ammunition Plant, IA (USACE Omaha) | 1999 | 4,740 tons | VOCs, RDX |
| Confidential client, MA USACE New England | Ongoing | 40,000 tons | RDX/ HMX, Perchlorates |
| Confidential Client | 2000 - Ongoing | 1,200 lbs/hr | M6 Propellant |
| Robstown | 2008 - Ongoing | 68,000 tons Annually | Hazardous Waste |
| Letterkenny Munitions Center, PA | 2009 – Ongoing | Live Testing Nov 2015; 10K cycles/yr | Ammonium Perchlorate |
| Buckmaster Depot and Taji ASP, Captured Enemy Ammunition Program, Iraq, (USACE Redstone, AL) | 2004 - 2005 | 40,000 tons and 340,000 pieces of UXO demolition | Conventional air and ground munitions including 1,000 tons of propellant |

With respect to handling bulk propellant, ECC conducted large scale propellant handling and destruction operations in Iraq in support of coalition forces as part of the Captured Enemy Ammunition (CEA) Program.

The ECC team destroyed more than 40,000 tons of munitions including 1,000 tons of propellants stored in 150 magazines, 400 revetments at Buckmaster Depot outside of Tikrit, and in 35 magazines and 40 revetments at Coalition Base Taji. Additionally, we collapsed 23 caches spread across 250 square miles of the Sunni Triangle in Iraq in highly urban (schools, hospitals, etc) and rural wadis and field storage points. We also cleared 430,000 pieces of UXO, some of which included mortar, artillery and tank propellants in bombed-out and destroyed munitions storage sites.

The types of propellants depended upon the munitions encountered, ranging from gun munitions, to tank, mortar and artillery rounds. Propellants were from more than 25 countries, but we encountered the equivalent of M1, M2, M6, M14, M15, M17 and M30 type propellants, including granular and stick configurations.

Part of the technical challenge with the CEA Propellant was the conditions of the magazines presented by Iraqi storage practices that were not in compliance with DDESB standards (incompatible munitions storage, i.e, propellant, HE or Illumination, fuzes and primers co-stored, many times in full-up configuration) as well as loose propellant that was dumped indiscriminately by looters amongst other munitions in the magazines, revetments or open caches (much of it 1.1 munitions, many of them already-fuzed (PD, VT or MT) HE and Illum artillery, mortar and tank rounds as well as mines, grenades and aviation ordnance). Of particular concern were magazines with loose propellant dispersed among illumination rounds, some already leaking. Additionally, there were no records of surveillance nor lot integrity, with propellant and munitions from different countries dating back to the 1930's, coupled with daily temperatures reaching to 130 degrees in a dry, high-static environment. This presented highly volatile working conditions that were simultaneously driven by high productivity requirements (minimum production of 100 tons per day demolition or burn).

ECC was able to safely and efficiently balance those requirements by developing comprehensive download processes that allowed for the safe removal of the propellant, subsequent Open Burn, and then download of the remaining munitions. These processes were part of a depot-level plan designed by-magazine, specifically for the challenges presented by that storage site while managing the depot efficiently to ensure maximum productivity and efficient use of manpower and MHE for the site as a whole. Safety and quality control procedures were paramount, as were actions-on preparations in the event of unforeseen events inside the wire, or from external attacks (mortar, rocket or direct attack either at our depot, or while conducting over-the-road convoys with munitions or in-field operations at remote caches).

ECC planned, implemented, and monitored an ammunition management and open burn or open detonation operation as well as convoy and site security that included 73 UXO and Munitions Technicians, 5 full-time medical personnel with mobile and static infirmary, 55 Expat Security Personnel, 390 Iraqi Security Personnel and 350 Iraqi munitions handlers, 28 Green and Yellow gear MHE, 2 Front-end loaders, one track loader, Six PLSs and 55 on/offload pallets, 63 Soft-skin pick-up trucks, 28 hardened vehicles, 2 Caspirs and 2 Mamba MRAP vehicles. Our teams were comprised of personnel from 17 different countries and at least 6 different native languages (English, Dari, Farsi, Filipino, South African, and Nepalese).

ECC's safety record was exemplary and we retain many of the American personnel from those operations that will be managing and performing the Minden work as well.

3) Describe how you will manage/handle the M6 and CBI from bunker to disposal of the waste generated in your process.

Clean Harbors / ECC Response 3: Our proposed process to manage and dispose of the M6 and CBI will be detailed as part of our proposal due March 18. Please see our responses to questions 6, 7, and 8 in the "Technology" section of this round of questions for additional detail.

Clean Harbors / ECC will establish and implement a 3rd party surveillance program to test and determine the stability of propellant in each magazine prior to download operations. All direct Management and Line Performance personnel will be trained/qualified Munitions and UXO specialists. Transfer procedures will be reviewed by a 3rd party explosive safety service firm prior to implementation.

4) Do you have sufficient capital to build all of your facilities prior to receiving funds from Louisiana National Guard?

Clean Harbors / ECC Response 4: Yes. Our proposed cash flow model and milestone payment plan will be part of our proposal due on March 18.

**Capacity & Throughput**

1) What is the throughput of an individual unit on an hourly basis?

Clean Harbors / ECC Response 1: Our proposed throughput will be in excess of 40t/day.

2) Can this technology operate 24/7?

Clean Harbors / ECC Response 2: Our units will be operating 24/7, with scheduled downtime for routine maintenance.

3) For a Batch process, describe the time for each batch, and break out the loading and unloading time along with the actual treatment time.

Clean Harbors / ECC Response 3: Our proposed treatment train design and cycle times will be outlined in our proposal due March 18, and additional detail will be available as part of the design review process upon award.

4) How many units will be used?

Clean Harbors / ECC Response 4: Our proposed treatment train design and cycle times will be outlined in our proposal due March 18, and additional detail will be available as part of the design review process upon award.

5) What kind of maintenance is required and how long will the unit be off-line?

Clean Harbors / ECC Response 5: Maintenance will be routine cleaning and troubleshooting to maintain efficiency. Downtime will be figured into our utilization calculations, which will be reflected in our schedule and forecast completion date. It is expected that maintenance could be completed if the units were off-line approximately one shift / month.

**Waste**

1) Describe in detail the continuous air monitoring equipment used for this technology.

Clean Harbors / ECC Response 1: The specific vendor for the continuous emission monitoring system has not been determined at this stage, but will be procured from a quality supplier like Emerson or California Analytical. The anticipated continuous emission monitoring system is standard, off-the-shelf equipment. Similarly, the stack testing specialty subcontractor and offsite analytical laboratory are unknown at this time but will be procured from a certified supplier like Maxxam Analytics for stack testing or GCAL for the offsite analytical laboratory analysis, which are both accredited by LDEQ.

2) What is the maximum Destruction and Removal Efficiency of organics on an ongoing basis and how will you ensure that it is met?"

Clean Harbors / ECC Response 2: The following stack tests using EPA promulgated methods are anticipated during commissioning and during operation as required. The detection limits of each test are in accordance with the promulgated methods.

| Pollutant | EPA Method |
|---|---|
| CO/O2 | 3a, 10 |
| Opacity | 9 |
| PM | 5 |
| Metals | 29 |
| NOx | 7 |
| SO2 | 6 |
| VOCs | 0030 |
| SVOCs | 0010 |
| TOM | 1-4, 18 |
| THC | 18, 25a |
| PCDD/PCDF | 23a |

The emissions for organic compounds, including the possible side products from the thermal treatment, will be determined by EPA Method 0030 during commissioning and periodically as required. The CO and THC analyzers of the continuous emission monitor systems (CEMS) then will be used as surrogate monitors during operation of the technology, along with the process control variables established during the commissioning stack test (i.e. temperature, residence time, flow rates, etc.). The use of CO and THC as surrogates is an EPA accepted method of monitoring per the emission ARARs. Stack testing using EPA Method 0030 can be added at scheduled intervals to verify emissions for organic compounds as required.

EPA Method 0030 will sample for a wide variety of standard organic compounds as determined by GC/MS, including the hazardous components of M6 (dibutyl phthalate and dinitrotoluene) and its degradation products. EPA Method 0030 is based on isokinetic stack sampling through sorbent cartridges and the detection limit of the sorbent cartridges is as low as 2 nanograms. The method detection limit can be decreased accordingly to evaluate lower concentrations by varying the volume of extracted stack gas passed through the sorbent cartridges.

It is not possible for the primary components of M6 (nitrocellulose, dibutyl phthalate, diphenylamine, and dinitrotoluene) to reform in our process, since the primary M6 components are converted to the thermodynamically favored carbon dioxide and water.

An activated carbon scrubber may be provided at the final emission point if required. Similarly, at an additional cost, the destruction and removal efficiency (DRE) for the M6 and its associated hazardous components can be increased to 99.9999% or higher, which is higher than the minimum emission criteria of 99.99% promulgated in the ARARs.

3) What is the estimated overall volume of waste from this technology? This includes all waste streams – air, water, and solids.

Clean Harbors / ECC Response 3: There is a single exhaust discharge from the treatment system at the stack following the air pollution control induction fan. The exhaust discharge will range from 175 to 190 standard cubic meters per minute (95 to 105 dry standard cubic meters per minute). To meet and exceed the ARAR criteria for emissions, the air pollution control will consist of a quench, baghouse, continuous emission monitoring system, and stack with associated process controls. The stack gas emission rate will range from ~1.5 to 2.0 dry standard cubic meters per pound of waste. The total amount of gaseous waste stream to be emitted will be ~2.5E+07 to 3.2E+07 dry standard cubic meters.

There is no waste water anticipated from this process.

We conservatively estimate that less than 4 pounds of ash will be generated for each 1,000 lbs of propellant treated. The final disposal location will depend on the results of waste sampling and characterization analysis in accordance with 40 CFR 261. We anticipate the ash to be non-hazardous.

4) How will you monitor/sample for each constituent in M6 and CBI in your waste stream?

Clean Harbors / ECC Response 4: The following stack tests using EPA promulgated methods are anticipated during commissioning and during operation as required. The detection limits of each test are in accordance with the promulgated methods.

| Pollutant | EPA Method |
|---|---|
| CO/O2 | 3a, 10 |
| Opacity | 9 |
| PM | 5 |
| Metals | 29 |
| NOx | 7 |
| SO2 | 6 |
| VOCs | 0030 |
| SVOCs | 0010 |
| TOM | 1-4, 18 |
| THC | 18, 25a |
| PCDD/PCDF | 23a |

The emissions for organic compounds, including the possible side products from the thermal treatment, will be determined by EPA Method 0030 during commissioning and periodically as required. The CO and THC analyzers of the continuous emission monitor systems (CEMS) then will be used as surrogate monitors during operation of the technology, along with the process control variables established during the commissioning stack test (i.e. temperature, residence time, flow rates, etc.). The use of CO and THC as surrogates is an EPA accepted method of monitoring per the emission ARARs. Stack testing using EPA Method 0030 can be added at scheduled intervals to verify emissions for organic compounds as required.

EPA Method 0030 will sample for a wide variety of standard organic compounds as determined by GC/MS, including the hazardous components of M6 (dibutyl phthalate and dinitrotoluene) and its degradation products. EPA Method 0030 is based on isokinetic stack sampling through sorbent cartridges and the detection limit of the sorbent cartridges is as low as 2 nanograms. The method detection limit can be decreased accordingly to evaluate lower concentrations by varying the volume of extracted stack gas passed through the sorbent cartridges.

It is not possible for the primary components of M6 (nitrocellulose, dibutyl phthalate, diphenylamine, and dinitrotoluene) to reform in our process, since the primary M6 components are converted to the thermodynamically favored carbon dioxide and water.

An activated carbon scrubber may be provided at the final emission point if required. Similarly, at an additional cost, the destruction and removal efficiency (DRE) for the M6 and its associated hazardous components can be increased to 99.9999% or higher, which is higher than the minimum emission criteria of 99.99% promulgated in the ARARs.

The following emission data is publically available from our team's confidential thermal destruction of waste M6 propellant in the U.S. This test data is from the commissioning of the unit, June 13-15, 2000. The unit is a permitted RCRA system. The measured destruction and removal efficiency was determined at 99.99997%. The measured destruction and removal efficiency was based on using one-half the detection limit from the stack testing, since the M6 components were not detected in the emissions.

| **Parameter** | **Units** | **Value** |
|---|---|---|
| *Thermal Oxidizer Feed* | | |
| M6 Feed Rate | lbs/hr | 1,222 |
| | MMBtu/hr | 8.2 |
| Ash Feed Content | wt.% | 0.3 |
| *Thermal Oxidizer & Air Pollution Control* | | |
| Oxidizer Exit Temperature | $^oF$ | 1,801 |
| Fabric Filter Pressure Drop | in. w.c | 8.84 |
| Fabric Filter Inlet Temperature | $^oF$ | 356.2 |
| Stack Flow Rate | dscfm | 2,637 |
| Oxygen Content | vol.% | 7.7 |
| Moisture Content | vol.% | 53.6 |
| *Stack Emissions* | | |
| CO | ppmv | 3.4 |
| HCl | ppmv | 0.05 |
| Total Chlorine | ppmv | 0.10 |
| PM | gr/dscf | 0.004 |
| Antimony | µg/dscm | 1.53 |
| Arsenic | µg/dscm | 0.30 |
| Barium | µg/dscm | 10.43 |
| Beryllium | µg/dscm | 0.04 |
| Cadmium | µg/dscm | 0.38 |
| Chromium | µg/dscm | 3.98 |
| Lead | µg/dscm | 577.25 |
| Mercury | µg/dscm | 0.16 |
| Nickel | µg/dscm | 5.55 |
| Selenium | µg/dscm | 0.85 |
| Silver | µg/dscm | 0.12 |
| Thallium | µg/dscm | 0.20 |

We do not have access to the actual solid or hazardous waste testing data since the system is operated by a third party but the ash is tested for hazardous waste characteristics per 40 CFR 261 (i.e., TCLP and reactivity) and disposed as non-hazardous waste.

There is no water effluent from the system, so there is no applicable effluent testing.

5) What are the plans for disposal of wastes generated by this technology?

Clean Harbors / ECC Response 5: We conservatively estimate that less than 4 pounds of ash will be generated for each 1,000 lbs of propellant treated. The final disposal location is unknown at this time and will depend on the results of waste sampling and characterization analysis in accordance with 40 CFR 261. We anticipate the ash to be non-hazardous, and accordingly will be disposed at Allied Waste Services (Minden, LA) or equivalent.

**Health and Safety**

1) Please describe any unique health and safety issues associated with the technology. This will include using multiple units and the potential for a propagating explosion or uncontrolled chemical reactions.

Clean Harbors / ECC Response 1: We will submit detailed Safety Plans prior to mobilization. Safety details will also be outlined in the proposal due on March 18. As part of the suite of Safety Plans, a Magazine Download Plan will be submitted addressing the handling of the material in the magazine area, which will include handling up to pretreatment. Our pretreatment process will enhance the stability of the material prior to the thermal oxidation. Our site layout will include setbacks depending on site terrain and other location-specific restrictions.

We appreciate the opportunity to address these questions and look forward to additional opportunities to provide information on our proposed solution to the cleanup of M6 and CBI at Camp Minden.

Sincerely,

Peter J. Mondeel, Proposal Manger
Clean Harbors North American Remediation Organization