**Mars Society**
**11111 8th Ave. W, Unit A**
**Lakewood, CO 80215 USA**
**303-980-0890 (Phone) 303-980-0753 (Fax)**
**www.MarsSociety.org**

February 22, 2011

Richard Dwyer
Licensing Administrator
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Subject: ReSubmission of Abandonment and Restoration Plan 3BC-MAR1014

Dear Mr. Dwyer:

Pursuant to the recent letter from Karen Kharatyan dated January 12, 2011, please find attached re-submission of the following revised document.

- Abandonment and Restoration Plan – Rev 02/22/2011

This document has been revised to address feedback provided in the January 12, 2011 letter. Please accept this submission on behalf of The Mars Society.

Also please reference the letter and testing data submitted to you by Jeremy Pretzsch of Elastec/American Marine, the manufacturer of the SmartAsh 100 Incinerator (a copy of that letter and testing data is included with this transmittal for your reference). That letter states that the SmartAsh 100 with OilAway Attachment is capable of meeting the Canada-wide Standards for Dioxins and Furans when burning human solid waste.

Should you have any questions, or if there is anything further which you require, please do not hesitate to contact me at your earliest convenience.

Sincerely,

Joseph E. Palaia, IV

2011 Field Season Director & Crew Commander
The Mars Society - Flashline Mars Arctic Research Station
joe@4FrontiersCorp.com +1-508-561-2232

Copy Robert Zubrin Mars Society

The Mars Society
Robert Zubrin, President
11111 8th Ave. W, Unit A
Lakewood, CO, 80215 USA
Email: zubrin@aol.com
Phone: 303-980-0890
Fax: 303-980-0753

# Abandonment and Restoration Plan

***for the Mars Society's Flashline Mars Arctic Research Station***
***Devon Island, Nunavut, Canada***

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## 1.0 Description of Camp & Exploration Operations

The Mars Society is a private international society dedicated to furthering the human exploration and settlement of the planet Mars. In July 2000, the Mars Society established a research facility at the Mars-like Haughton impact crater site on Devon Island, Nunavut, called the Flashline Mars Arctic Research Station (FMARS). Designed to simulate a landed spacecraft on Mars, the FMARS project serves three goals:

1) To provide a testbed for studying the many aspects of field exploration operations on a human mission to Mars.
2) To provide a capable field research laboratory to help further our understanding of the Arctic, the Earth, Mars, and the possibilities and limits of life on our planet and beyond.
3) To inform and inspire people around the world to greater interest in space and science by bringing before them in a tangible form the vision of human exploration of Mars.

The research program carried out at the FMARS is unique. For four to five weeks during the arctic summer, a six person crew of scientists and engineers attempts to conduct a sustained program of field exploration in Devon Island's polar desert, while working under the same operational constraints as a human expedition exploring Mars. The crew lives in a combination habitat/laboratory module that is an architectural duplicate of a Mars mission unit. Anyone leaving the station to do field research needs to wear a simulated spacesuit, that limits the mobility, agility, dexterity, and sensory abilities of the wearer much as a real spacesuit would, and communication between EVA team members separated by more than a few feet has to be done by suit radio. While in the station, crewmembers also perform laboratory analysis of samples brought in from the field, repair equipment, write reports (which are exchanged with Mars Society's Mission Support group via a satellite link that imposes a Mars-like delay on communications), and engage in the chores of daily life living together as a team. The purpose of conducting such simulated operations is to gain essential knowledge of Mars exploration tactics, human factors issues, and engineering requirements – in short, to start learning how to explore Mars.

We have conducted highly successful field programs from the station during the 2001, 2002, 2003, 2004, 2005, 2007, and 2009 field seasons. These have added a great deal to our understanding of the requirements for human Mars exploration. In addition, press coverage of this activity has served to inspire many young people with the adventure of science, thereby encouraging them to consider a career path that will be of great benefit to both them and society at large.

1.1 Campsite

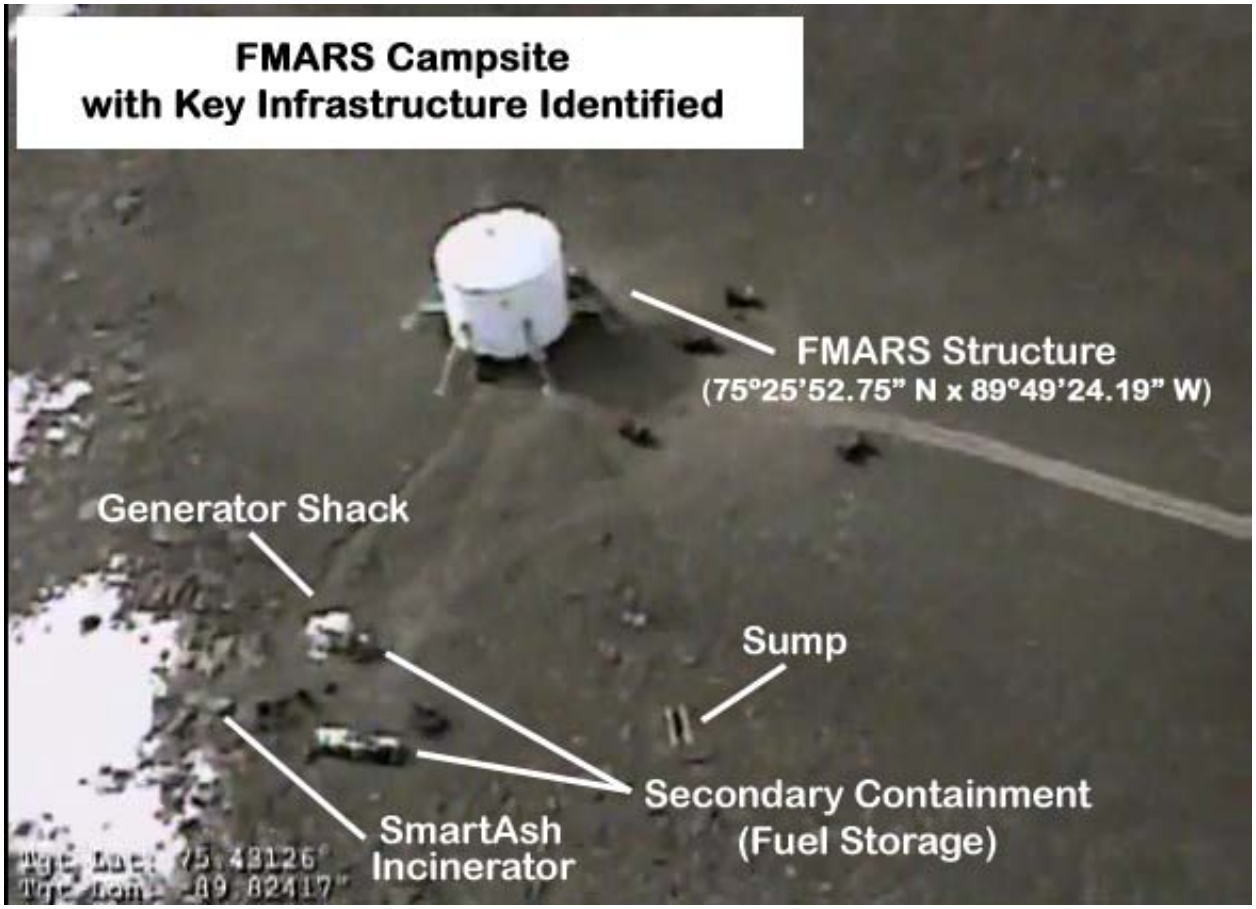


**Diagram 1 – Immediate Vicinity of the FMARS Habitat, Showing Key Infrastructure (Image Captured in July, 2009)**

The FMARS campsite consists of several key pieces of infrastructure. These include the FMARS structure, a small generator shack, a sump, secondary containment areas for fuel and lubricant storage, a smart ash incinerator, and misc small equipment and tools which are brought to the site to support each field season (for example, ATVs).

The FMARS structure is a free-standing ~9M diameter cylinder made of reinforced fiberglass panels with wood flooring. The structure is roughly three stories tall. The interior is outfitted to approximate the design of an early exploration-phase Mars habitat. Simulated "landing legs" are affixed to the exterior of the structure to increase visual similarity between the structure and a comparable Mars exploration habitat. An antenna mast runs vertically along the side of the habitat and continues for a short distance above the roof of the structure.


**Diagram 2 – The FMARS Structure**
**(Image Captured in July, 2009)**

## 1.2 Fuel Storage

The FMARS facility makes use of petroleum products (mo-gas, diesel, jet-b, and engine lubricants). No more than 20 drums of these products are on hand at any one time at the facility for servicing of transportation, heating, and electrical generation. In no case will there be 4,000 or more liters on the camp site at any time.

Temporary storage of full fuel and engine lubricant containers for less than 24hrs is at a site near the airstrip located at 75º25'53.02N x 89º49'20.92W. A secondary containment area will be put in place at this location during the 2011 field season.

Permanent on-site storage of fuel containers will be on the secondary containment area, located in the proximity of the generator shack at 75º26'01.65N x 89º51'15.44W, or in the generator shack. Both of these areas are lined with heavy gage plastic film, are covered by fuel absorbent material with the edges elevated by rocks or soil, and are of adequate size and volume to contain and hold fluids for the purpose of preventing spills. Both areas are located several hundred meters from the nearest water body.

ATV refueling and lubricant changes take place within secondary containment areas, as depicted.


**Diagram 3 – Secondary Containment for Permanent Fuel Storage and for Storage of Waste Oil**
**(Image Captured in July, 2009)**



**Diagrams 4 & 5 – Secondary Containment for Fuel Storage (adjacent to generator shack). Refueling of ATVs and lubricant changes take place within secondary containment area.**
**(Images Captured in July, 2009)**

## 1.3 Campsite Sewage Disposal

Human liquid wastes are collected within a 55 gallon drum and shipped off-site for appropriate disposal through approved methods.

Human solid wastes are collected and burned within the on-site SmartAsh 100 Incinerator by Elastec, which is an approved human solid waste disposal method. The SmartAsh 100 Incinerator is equipped with an "Oil Away Attachment" which permits the use of waste oil, ensuring complete combustion of human solid waste, despite its high moisture content and low heat content. This ensures that the human solid waste is completely combusted and prevents the release of pathogens into the environment. A letter from the incinerator manufacturer has been provided to the Nunavut Water Board stating that this incinerator is capable of meeting the Canada-wide Standards for Dioxins and Furans emissions when burning this type of waste. Residual ash is collected in approved containers and flown off-site for appropriate disposal through approved methods. The quantity of ash disposed of in this manner is recorded. All on-site staff are trained in proper Incinerator operation.

## 1.4 Solid Waste

The FMARS program manages its generated waste streams. This includes waste segregation and purposefully purchasing food and other products with reduced amounts of packaging materials.

Acceptable food waste, paper waste and untreated wood products are stored within the FMARS structure and periodically burned within the on-site SmartAsh 100 Incinerator by Elastec. Residual ash is collected in approved containers and flown off-site for appropriate disposal through approved methods. The quantity of ash disposed of in this manner is recorded. All on-site staff are trained in proper Incinerator operation.

**Diagrams 6 & 7 – On-Site SmartAsh 100 Incinerator**
**(Images Captured in July, 2009)**

All other wastes are stored within the FMARS structure within approved containers during the field season and flown off-site for appropriate disposal through approved methods. This includes plastics, electrical wire, and other wastes likely to produce dioxins and furans when burned.

Records are maintained throughout the season to record all waste flown off-site and records of confirmation of proper disposal are also maintained.

## 1.5 Waste Oil

Waste oil is stored within a dedicated 55 gallon drum which is stored within the secondary containment area. All lubricant changes take place within secondary containment areas.

## 1.6 Hazardous Waste

No hazardous wastes are used on site.

## 1.7 Drill Holes, Cores and Sumps

During the 2009 field season, a sump (as depicted) was installed. It was located approximately to the north of the FMARS structure. The sump was located above the high water mark of all surrounding water bodies. It was located several hundred meters from the nearest water body.

Greywater is collected from within the habitat and periodically poured into the sump throughout the field season. It is screened to ensure only greywater is deposited in the sump, with no residual food or other particulate matter.

**Diagram 8 – Sump Used During the 2009 Field Season**
**(Image Captured in July, 2009)**

## 1.8 Bulky Items

No particular bulky items, beyond those already listed, are used on-site.

## 1.9 Water Intake

Water is collected by hand and transported in jugs and plastic barrels from the nearby creek in a manner fully compliant with all applicable regulations. Records are kept of the amount of water collected and of the source from which that water was collected.

## 1.10 Helicopter Landing Pad

There is no helicopter landing pad on site.

## 1.11 Generator

The FMARS program makes use of two Yanmar Diesel Generators in order to generate electricity on-site. These generators are stored within a generator shed located at 75º26'01.65N x 89º51'15.44W, which is a free standing wooden structure.

The interior of the shed has been established as a secondary containment area. Lubricant changes and refueling takes place within this area. Notice also the Spill Response Plan (yellow background in picture) which has been affixed to the generator shed for immediate reference by crew members in the event of a spill.


**Diagram 9 – Interior of Generator Shed, Showing Diesel Generators & Secondary Containment. (Images Captured in July, 2009)**

## 2.0 Description of Final Abandonment and Restoration

### 2.1 Proposed Time Frame and Restoration of Camp

We ship out generated wastes every season. No waste is left on-site.

No alternations to the terrain have been done, and none are anticipated.

The only permanent item is the station structure itself. At the end of our program, we will either take this down, or, if the authorities prefer, we will donate it to the Nunavut Territory so it can continue to be used by Inuit hunters as a winter emergency shelter.

At the end of our program, the site will be returned, as closely as possible, to the original condition it was found in at the beginning of our program.

### 2.2 Fuel Storage and Re-Fueling Areas

At the end of our program, all fuel stored on site will be removed. Fuel storage and re-fueling areas (secondary containment areas) and all associated materials and equipment will be removed.

### 2.3 Grey-Water Sump

At the end of our program, the grey-water sump will be backfilled.

### 2.4 Solid Wastes

All solid wastes generated during the field season are managed as previously stated in this document. At the end of our program, all solid wastes will be removed.

### 2.5 Waste Oil

All waste oil generated during the field season is managed as previously stated in this document. At the end of our program, all waste oil will be removed.

### 2.6 Hazardous Waste

No hazardous wastes are used on site.

### 2.7 Drill Sites

No drill sites exist on-site.

### 2.8 Sumps and Cuttings

At the end of our program, the grey-water sump will be backfilled.

2.9 Bulky Items

No particular bulky items, beyond those already listed, are used on-site.

2.10 Water Intake

During each field season, water is collected by hand and transported in jugs and plastic barrels from the nearby creek in a manner fully compliant with all applicable regulations. Records are kept of the amount of water collected and of the source from which that water was collected. At the end of our program, all equipment and materials used in water collection will be removed.

2.11 Helicopter Landing Pad

There is no helicopter landing pad on site.

2.12 Generator

At the end of our program, both on-site generators as well as the generator shed used to house them will be removed. All related materials and secondary containment areas will also be removed.

*Please note that the following documents were referenced in the preparation of this Abandonment and Restoration Plan:*

*"Part I – Conditions Applying to Abandonment and Restoration or Temporary Closing" of Water License 3BC-MAR1014*