



Presented to:

Global Demilitarization Symposium

Liquid Propulsion Demilitarization and Disposal Program



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Product Manager for Demilitarization
Army Aviation and Missile Command
Missile Defense Agency
Anniston Defense Munitions Center



Army Aviation and Missile, Research, Development, and Engineering Command
Weapons Development and Integration Directorate



Missile Sustainment Function Team
Propulsion Technology Function Team
Materials Analytical Laboratory Team
Army Testing and Evaluation Command
Redstone Test Center





Liquid Propulsion Demilitarization and Disposal Program (LPDDP)



Purpose:

- The LPDDP was developed for the purpose of addressing the procedures and processes for disposition of the aging liquid propulsion inventory
- Assemble subject matter experts, technical expertise, and to facilitate the execution of the LPDDP
- Specifically targeting the Lance and Bullpup propulsion units



Liquid Propulsion Demilitarization and Disposal Program (LPDDP)



LPDDP Background:

- On December 2, 2014, a Lance storage container at the Anniston Munitions Center (ANMC) was found to be leaking. An emergency response action (ERA) was issued to address the leaking Lance Main Missile Assemblage (MMA). The ERA team was deployed and resolved the leak situation.
- The ERA team members included ANMC, Aviation and Missile, Research, Development, and Engineering Command (AMRDEC), Army Test and Evaluation Command (ATEC), Redstone Test Center (RTC), and the Aviation and Missile Command (AMCOM) was assembled, deployed and resolved the leak situation.
- The Liquid Propulsion Demilitarization and Disposal Program (LPDDP) was developed to engage the technical expertise and facilitation necessary for the purpose of developing a process for the disposal of the aged Lance Main Missile Assemblage (MMA) and the Bullpup rocket motor (BRM) current inventory.
- The LPDDP consists of:
 - Phase I - Lance MMA inventory at the RSA
 - Phase II - Lance MMA inventory at the Anniston Munitions Center
 - Phase III - BRM inventory at the Hawthorne Ammunitions Plant

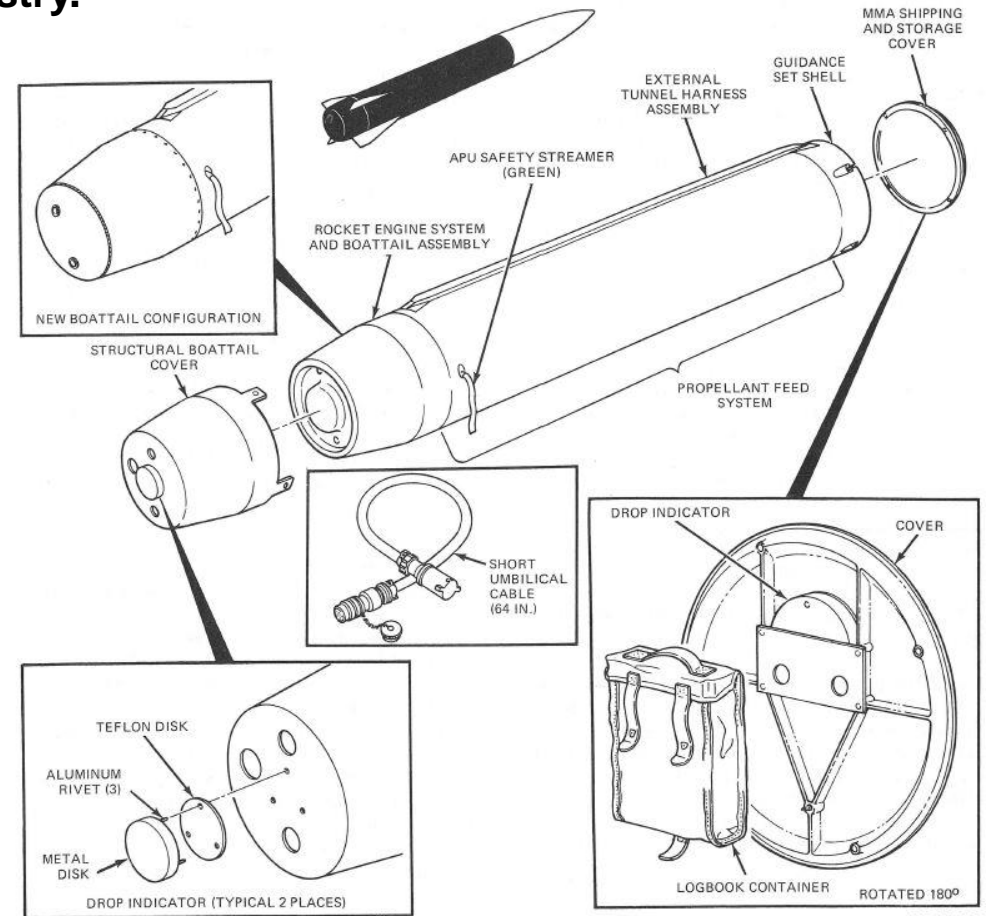
Liquid Propulsion Demilitarization and Disposal Program - LANCE



The 1970's vintage Lance motors developed by the United States for surface-to-surface field artillery combat, and was used to provide both nuclear and conventional fire support. The current inventory of Lance MMAs have been de-commissioned however, many are used as targets in the defense development industry.

The Lance propulsion functions very similar to the Bullpup with the addition of the guidance and control unit and the engine

Main Missile Assemblage Propulsion Unit



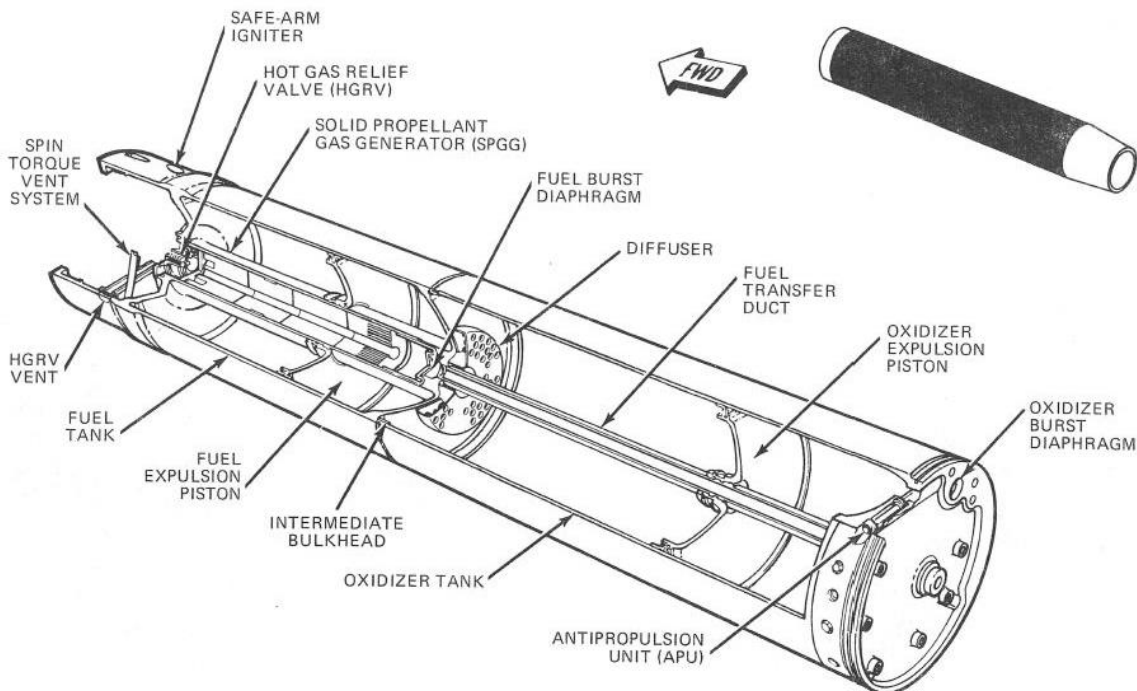
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Liquid Propulsion Demilitarization and Disposal Program - LANCE



Main Missile Assemblage - Feed System

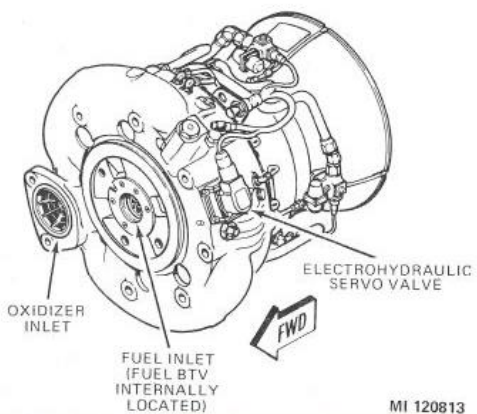
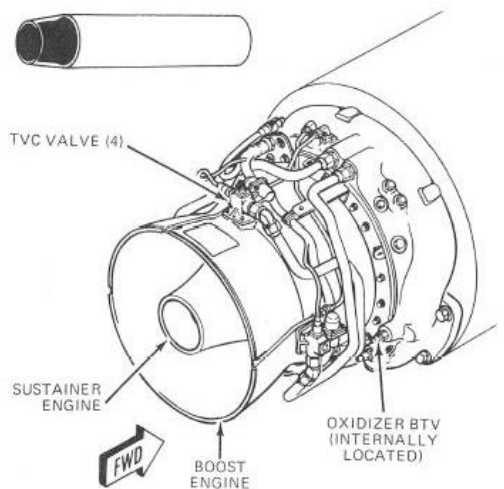


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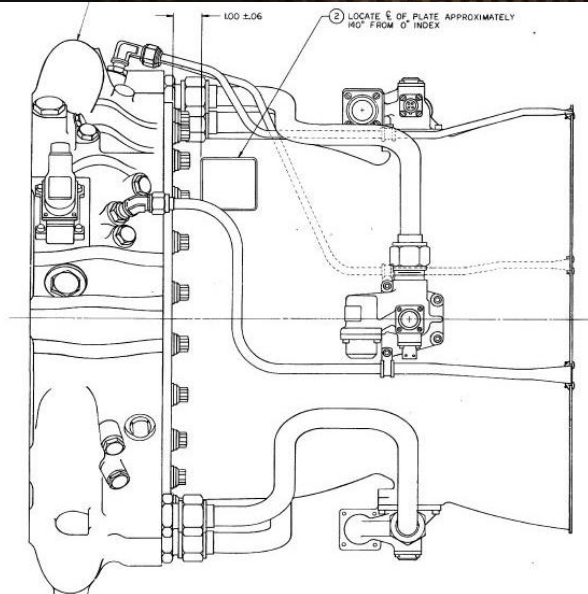
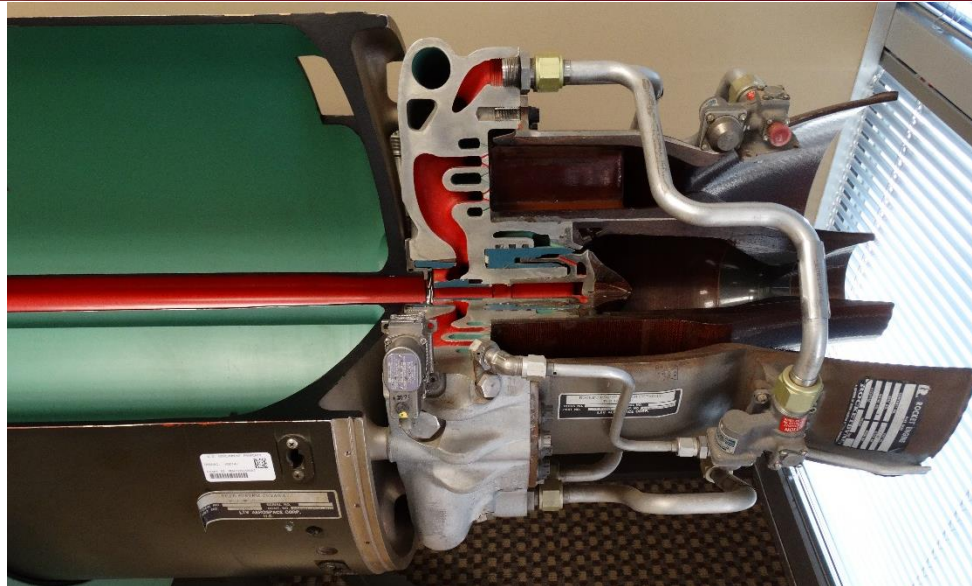
Liquid Propulsion Demilitarization and Disposal Program - LANCE



Main Missile Assemblage - Engine



MI 120813



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LPDDP Phase I Results Lance



On October 22, 2014 personnel from the ANMC and AMRDEC investigated a report of a potential liquid propellant leakage from an ANMC ECM storing 18 Lance liquid propulsion rocket motors.

The response team used the appropriate personal protection equipment and Interscan® monitoring units to capture independent readings for the fuel and oxidizer in a sequenced approach.



LPDDP Phase I Results

Lance



- On December 2, 2014 personnel from the ANMC and the AMRDEC conducted a follow-on air monitoring of the Lance rocket motor leak issue.
- The K701 ECM was monitored at the exterior vent which indicated a positive reading for the oxidizer and negative for the fuel.
- During the monitoring activity on December 2, 2014 a puddle of nitric acid was noticed on the floor near a Lance container.



Nitric Acid Accumulation on ECM Floor



MMA Container with Evidence of Nitric Acid Release



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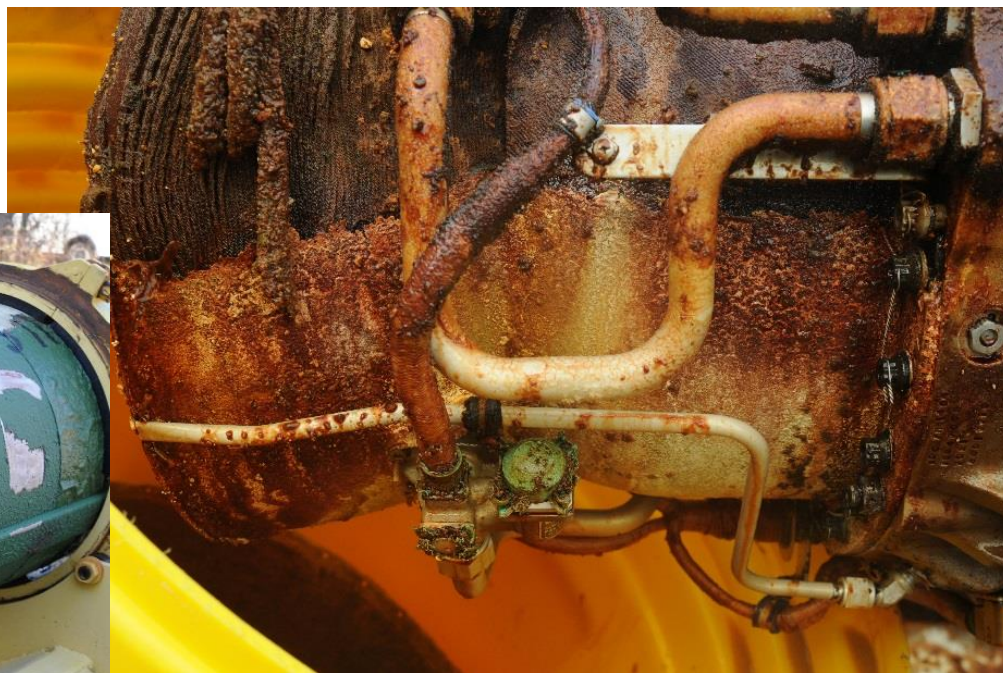
LPDDP Phase I Results

Lance



December 6, 2014, the response team de-canned the subject Lance propulsion unit for the purpose of de-tanking the oxidizer from the unit and also the de-contamination procedure for the ECM, motor container, and the other two contaminated shipping containers.

MMA Feed System with Leak Signature



MMA Engine with Severe Corrosion



LPDDP Phase I Results

Lance



Two possible suspect areas are the oxidizer burst disc and the welded port on the aft end of the propulsion unit. From an external view port, visibility of the burst disc indicates severe corrosion along its serrations. From the port weldment, a distinct leak signature was visible from the weld location down to the lower portion of the feed system's aft end face.



- **On April 7th, 2015, members of the Aviation and Missile Command (AMCOM), AMRDEC, Missile Defense Agency, the Redstone Test Center, RSA Garrison, RSA Safety and Environmental, and the Product Manager for Demilitarization convened to stand up the Liquid Propulsion Demilitarization and Deposal Program (LPDDP)**
- **A working group (WG) was formed with the task of developing the path forward for disposition of the remaining 27 Lance MMA inventory at RSA and the 46 Lance MMA inventory at the ANMC. The LPDDP Phase III (BRM) is supported by the Safety and Condition Assessment (SCA) completed by the AMRDEC prior to the formation of the LPDDP and will be utilized as the bases for BRM disposition processes.**
- **The LPDDP Phase I (Lance at RSA) falls under the Operation Order (OPORD 15-120) issued by LTG McQuiston (Retired) mandating that all unserviceable munitions on the RSA must be removed from inventory by September 30, 2015.**



Summary and Conclusion



- On June 11th, the LPDDP Phase I WG completed the disassembly and de-tanking of the first Lance MMA. The Phase I effort was completed on September 24th, 2015 eliminating 27 Lance MMAs from the inventory and ahead of schedule
- Liquid propulsion demilitarization and disposal sheds new light for the Demil Enterprise with its unique requirements. The LPDDP Phase I effort was prompted by the Lance MMA leak at the ANMC and forced the Demil Enterprise as well as item manager to face the reality that these aged motors must be properly removed from the inventory.



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LPDDP Phase I Results

Lance



During the LPDDP Phase I effort at the RSA, a second Lance MMA (Serial Number 4655) was found to have experienced a leak. As indicated in the image below, the resultant exposure to what appears to have been a nitric acid vapor leak since the upper portion of the MMA and the lid of the container were effected. MMA serial numbers 4756 and 4655 was a product of refurbishment approximately 10 years prior the current de-tanking. There remains one MMA at the ANMC that was also refurbished and is currently under close surveillance.



Vapor Leak Signature

- **In comparison, solid propulsion motors generally do not require the unique handling as is the case for liquids.**

- **LPDDP Phase I included:**
 - **the facilitization of two sets of de-tanking equipment specifically designed for Lance MMAs**

 - **full personal protective gear due to the corrosive hazard and toxicity of the chemicals**

 - **open burn and open detonation for the solid propellants, thermal battery function and disposal**

 - **aluminum drums for the fuel and stainless steel drums for the oxidizer, and the coordination for the use of the Defense Logistics Agency disposal contract vehicle for the disposition of the fuel, oxidizer, and rinsate.**



Liquid Propulsion Demilitarization and Disposal Program

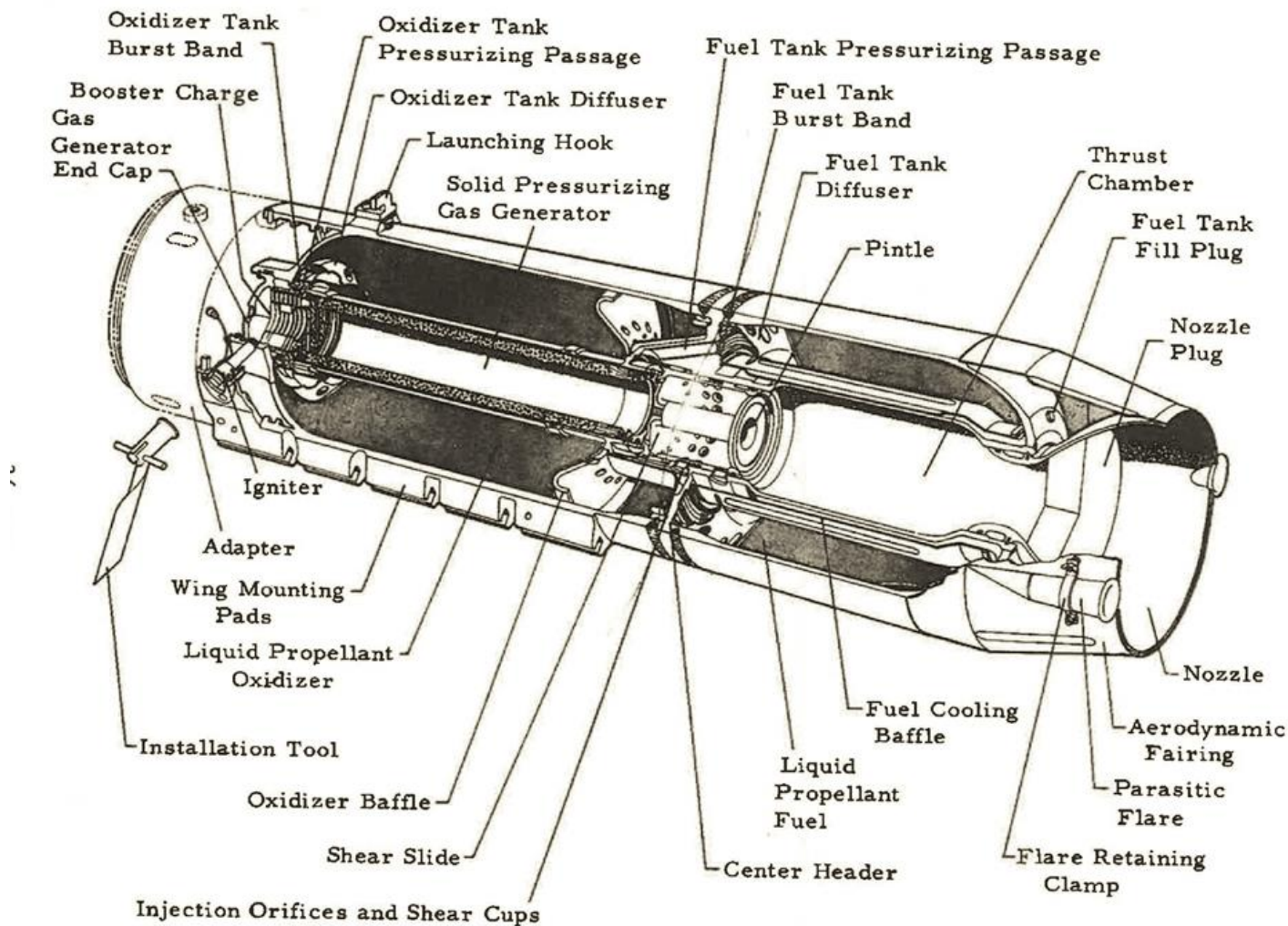


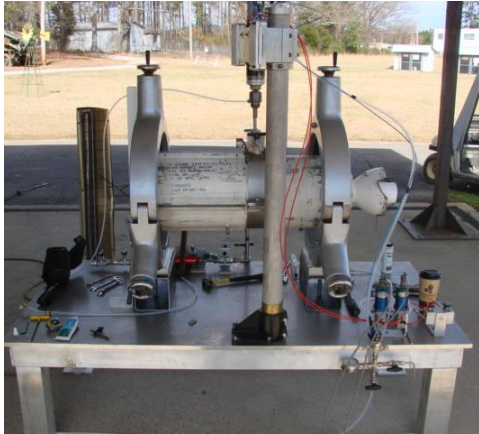
AGM-12 Bullpup

- **These 1960's vintage rocket motors were developed in the United States as the first mass-produced air-to-surface command guided missile.**
- **The casing is 2014 -T6 aluminum.**
- **The forward bulkhead provides access to the gas generator (GG) chamber.**
- **Together, the forward bulkhead and GG chamber form closure and the inner wall for the fuel tank configuration.**
- **The outer skin of the motor casing and the mid-section bulkhead complete the fuel tank.**
- **The aft bulkhead and combustion chamber form the aft closure and the inner wall of the oxidizer tank configuration.**
- **The outer skin of the motor casing and the mid-section bulkhead complete the oxidizer tank.**
- **Attached to the aft bulkhead is the nozzle. The nozzle provides mounting structure for the flares.**

Liquid Propulsion Demilitarization and Disposal Program

AGM-12 Bullpup





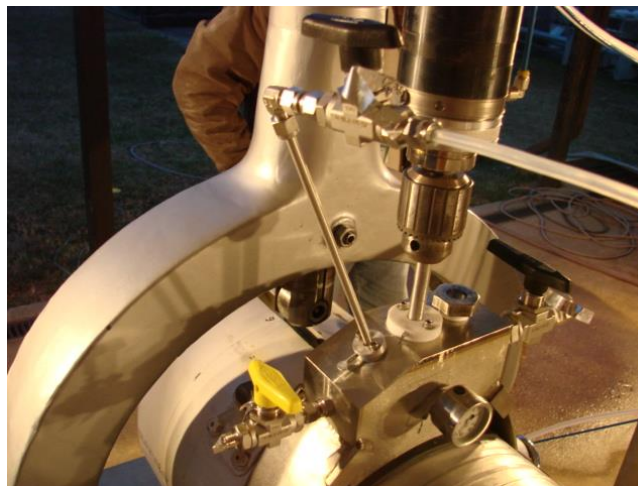
De-tanking

- General Arrangement
- The "Hat"
- Peck Drill
- Collection

General Arrangement

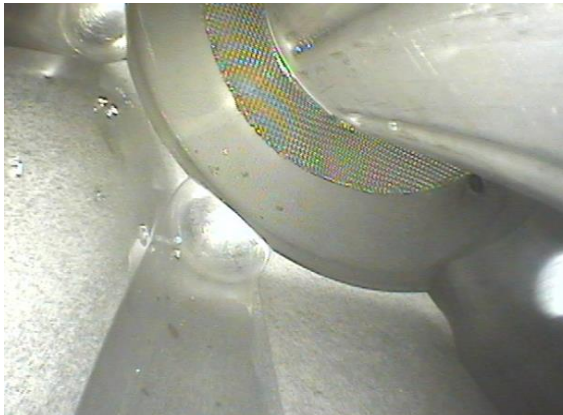


The "Hat"



Peck Drill

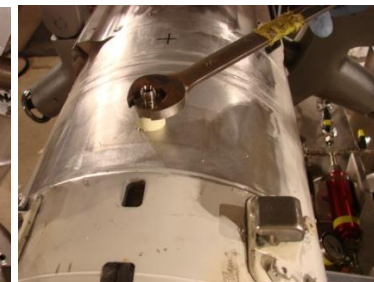
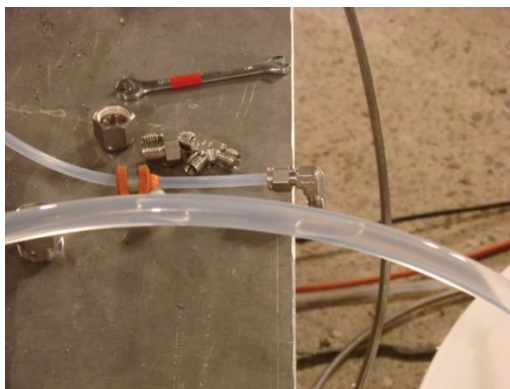




MAF-1 Analysis

- General Arrangement
- Bore-scope
- Pipeline Flow
- Filter Residue

MAF-1 Extraction



Tapping/Porting the Drill Hole



IRFNA Analysis

- General Arrangement
- Bore-scope
- Pipeline Flow
- Filter Residue

IRFNA Extraction



Tapping/Porting the Drill Hole

Bullpup De-tanking Results

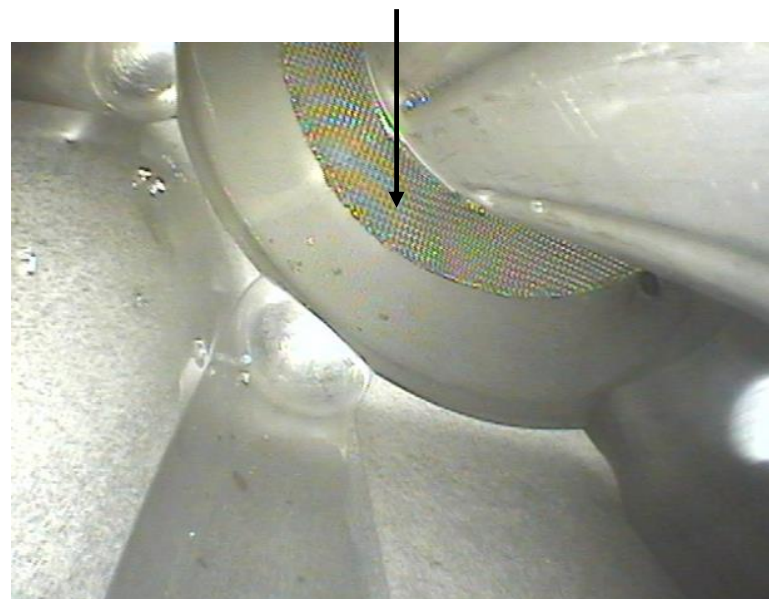
- **MAF-1 Continues to very near the original specifications**
- **Fuel Tank exhibited slight discoloration of the polished 214 T6 aluminum after long term storage**
- **Stainless steel diffuser remains in place**

MAF-1 Gas Chromatography Analysis

Within Specifications

UDMH	41.40%
Acetonitrile	13.23%
Water	0.43%
DETA	44.04%

Stainless Steel Diffuser



Fuel Tank

Bullpup De-tanking Results

- Generally, IRFNA contains .6% to .8% HF compared to the sample extracted from a LR-58 at .11%.
- Oxidizer tank gives evidence of HR depletion. Solids were found in the extracted oxidizer as well as being left behind in the tank.
- The solids that appear greenish in color and are the results of the complete erosion of the stainless steel screen

Sample	Bullpup IRFNA	Specifications (Domestic)
% Total Acid	101.24	N/A
% NO ₂	19.18	13.0-15.0
% HF	0.11	0.6-0.8
Specific gravity (60°F)	1.621	1.564-1.575
% Residue	2.44	0.10 max
% Metallic Nitrate	10.22	N/A
% HNO ₃	65.54	81.7-84.9
% Water	4.95	1.5-2.5

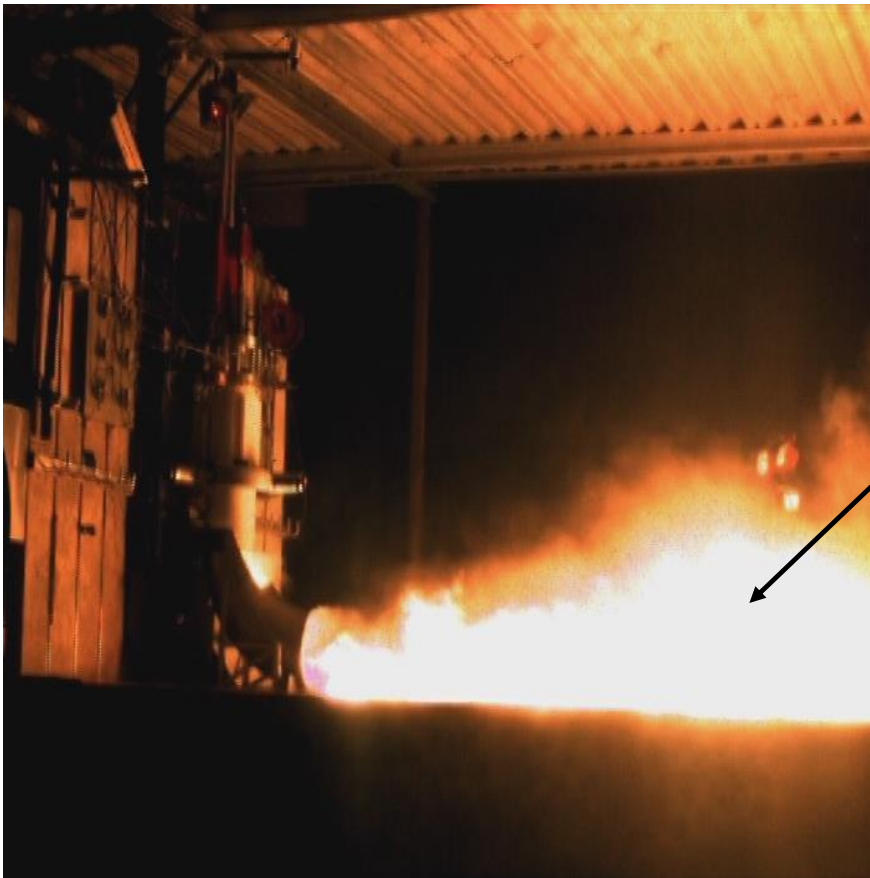
IRFNA Analysis



Solids in the IRFNA Tank

LR-58 Bullpup Static Fire

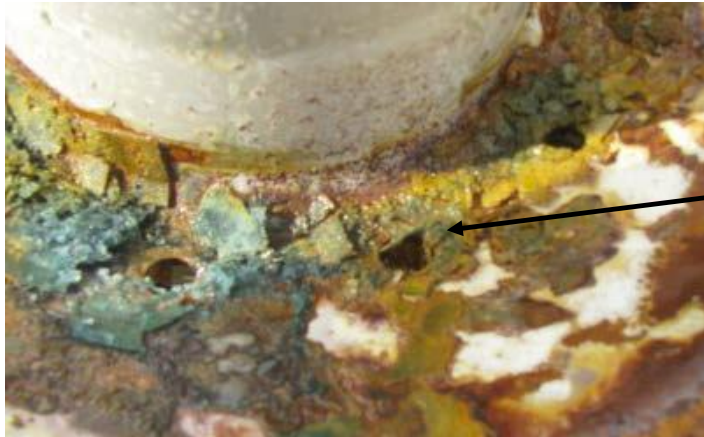
- The intent: a potential disposition path for the BRM Inventory
- The static fire combustion event created a fuel rich combustion event
- A heavy IRFNA plume was forced out the motor post the visible combustion event.



White Coloration
of the Plume
Indicates Fuel
Rich Combustion

LR-58 Bullpup Static Fire

- Post static fire examination of the motor carcass revealed that approximately 48% of the oxidizer injectors were not flowing IRFNA during the combustion event.
- The restricted flow was attributed to the solids that had precipitated from the IRFNA due to the depleted HR.

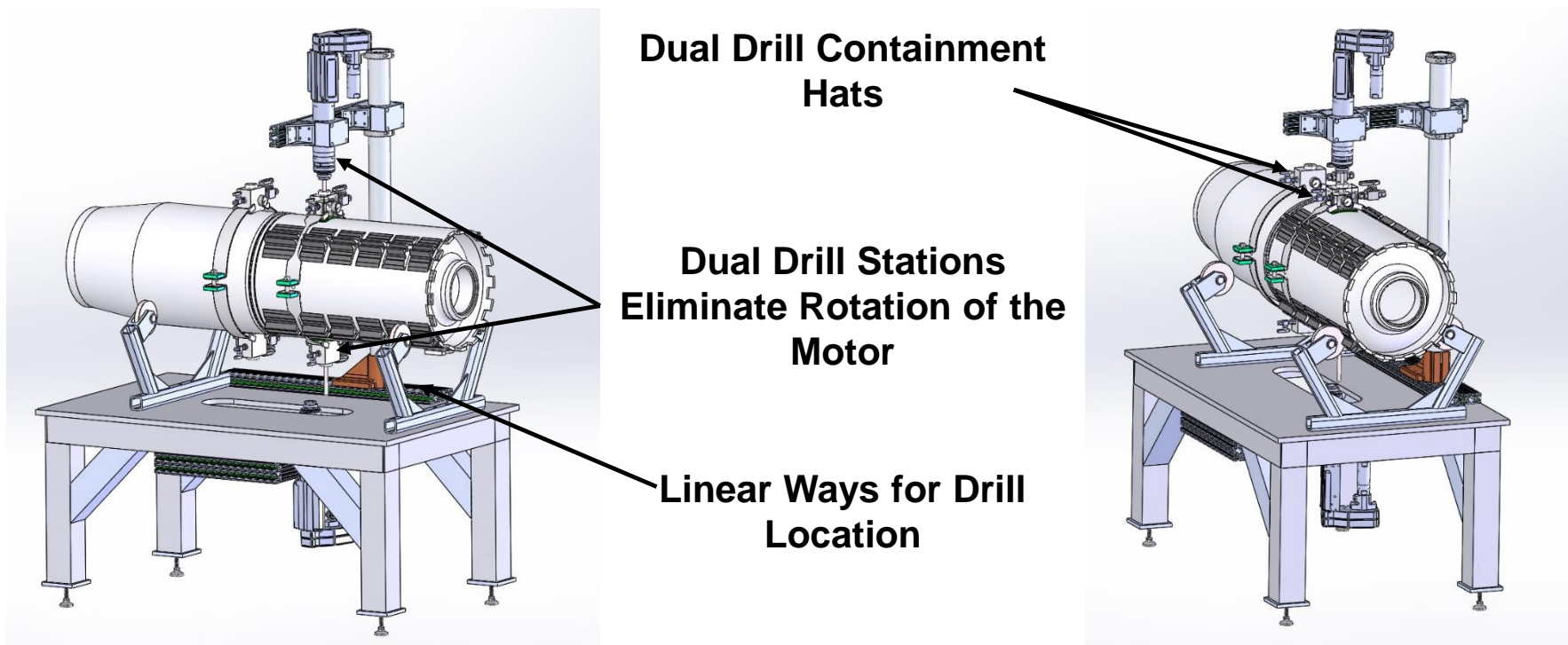


Oxidizer Injector Orifices

Solids Inside the Oxidizer Tank



- Phase III de-tanking equipment fabrication and assembly underway
- Enhanced capability to reduce touch labor and increase through put
- Dual drill system on linear ways
- Drilling tanks, de-tanking, and tank rinse executed as remote operations





LPDDP Future Work

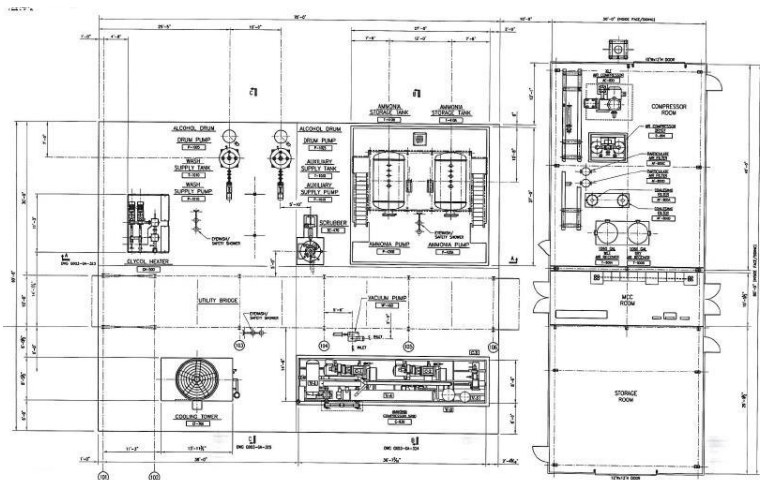


- **The LPDDP Phase II (Lance at the ANMC) and Phase III (Bullpup) are planned for fiscal 2016 and 2017 respectively. Although the Bullpup SCA was completed before the onset of the LPDDP Phase I, the SCA findings projected that the Bullpup inventory is currently safe to store and safe to transport**
- **The RSA prototype equipment that was used to de-tank the BRMs during the SCA is currently being transitioned to production scale to enhance production through put and reduce the touch labor. Due to the configuration of the BRMs, the de-tanking equipment is unique and therefore, not applicable to the Lance MMAs**
- **As a result of the Lance MMA leaks, the LPDDP Phase I and Phase II were determined to be priority over the older Bullpup inventory. Currently, the LPDDP WG is working the facilitation of Phase II at the ANMC and targeting January 2016 for LRIP.**

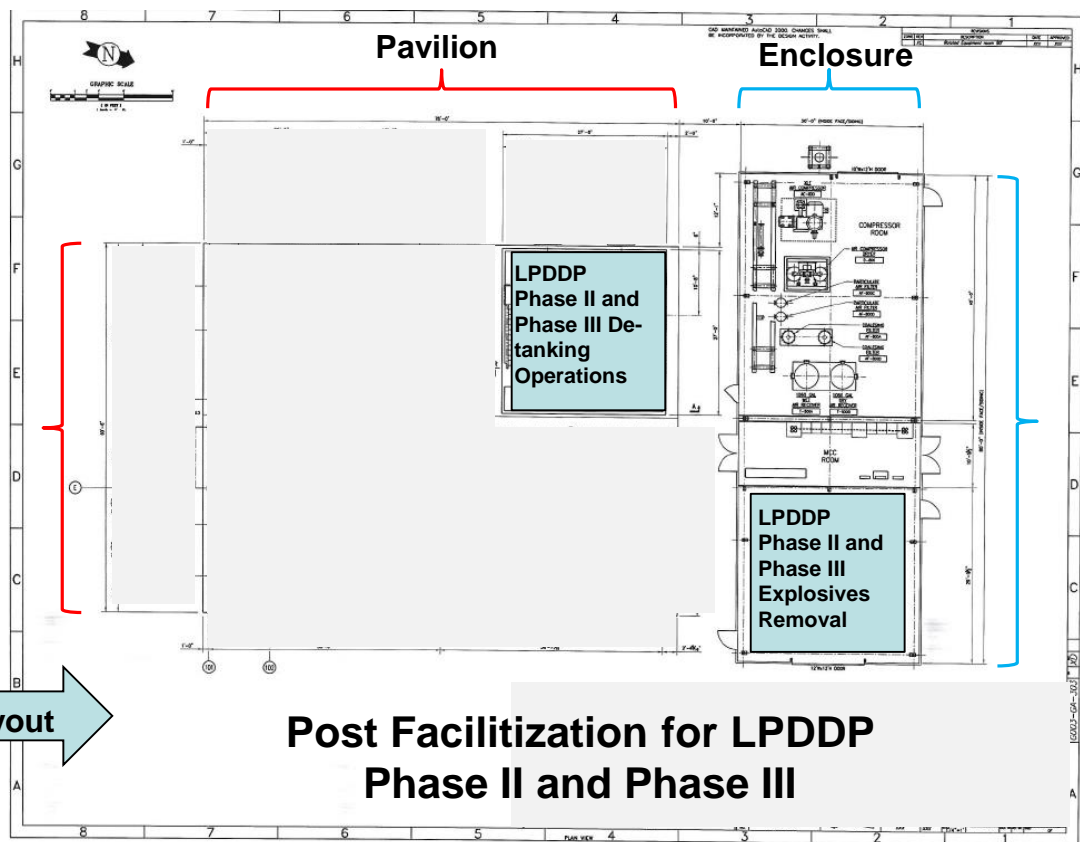
LPDDP at the ANMC = LPDDP Cost Reduction

- Environmental approval in place
- Explosive Safety Plan covers Phase II & Phase III
- Facilitization covers both Phase II & Phase III
- Cross pollination of Phase II & Phase III Equipment

Re-Purpose Current Site



**Explosive Processing Support
 Equipment Removal**



**Post Facilitization for LPDDP
 Phase II and Phase III**



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