

Holston Army Ammunition Plant Modernization: New Explosive Synthesis and Expanded Production Capability

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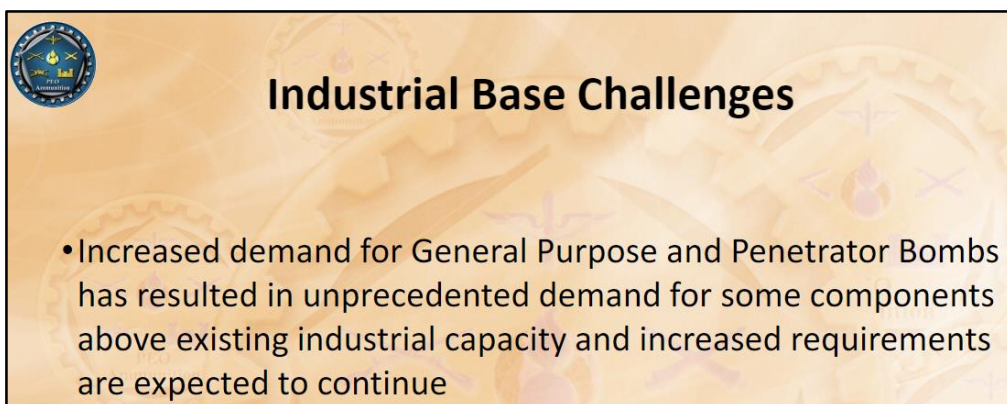


Briefing Contents

- Backdrop
 - Increasing Demand for Conventional Ammunition
 - Driving DoD Demand for RDX, NTO, DNAN, HBD-NQ and Others
 - Production Capacity Expansion via HSAAP Modernization
- Disruptive Forces
- HSAAP Chemistry – our Past & Future
- (Illustrative) Traditional vs Future OSI R&D Role
- What might this mean for Industry R&D for Military Explosives
- Summary

Backdrop – Increasing Demand for Conventional Ammunition:

- 2018: NDIA MES Conference – “Industrial Base Challenges”
- 2019: General Perna, CG US Army AMC:
 - "Industrial base **Readiness** is our ability for our arsenals, depots and ammunition plants and commercial industry partners to operate, adapt and **modernize...**"



Industrial Base Challenges

- Increased demand for General Purpose and Penetrator Bombs has resulted in unprecedented demand for some components above existing industrial capacity and increased requirements are expected to continue



NDIA
National Defense Industrial Association

**Industry- Government Panel
Munitions Executive Summit**

“The Eye of the Storm”
Addressing the Dramatic Increase in Explosive Requirements

GENERAL DYNAMICS
Ordnance and Tactical Systems

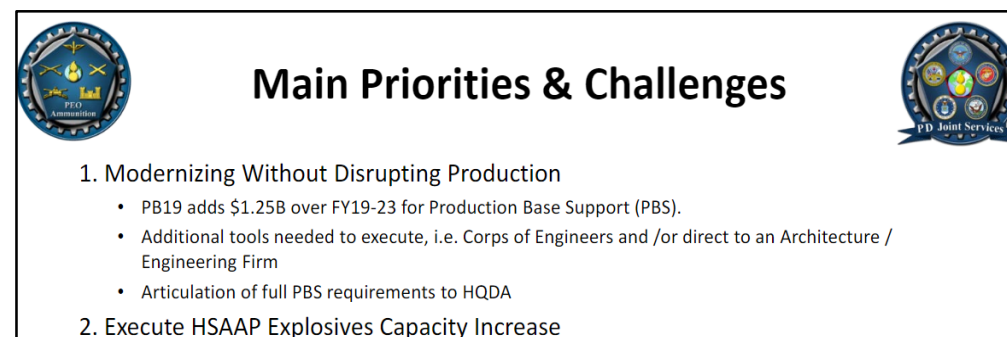
Azimuth
ORDNANCE

Chemring
Ordnance

BAE SYSTEMS
INSPIRED WORK

AFLI **NSA** **PSA**

“Eye of the Storm”

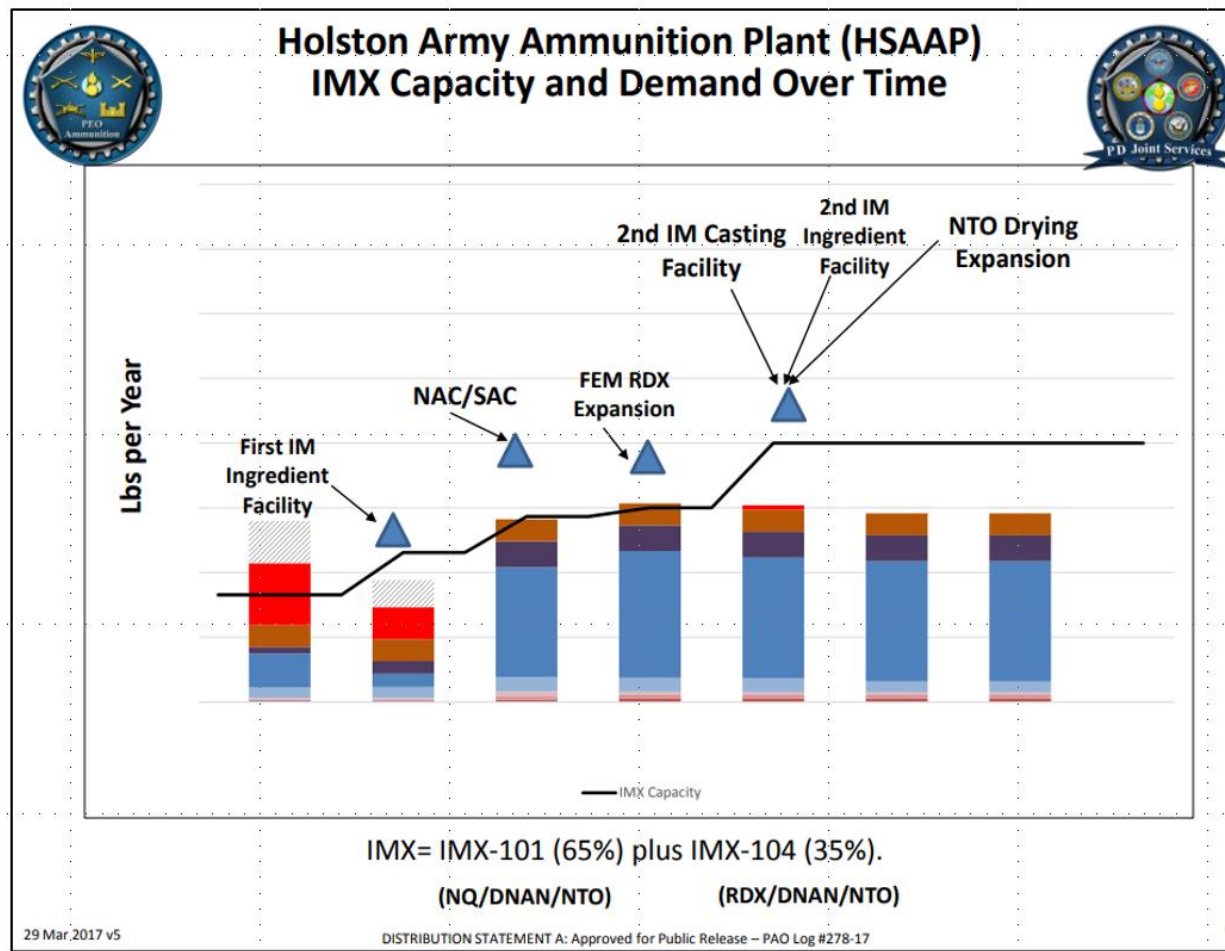
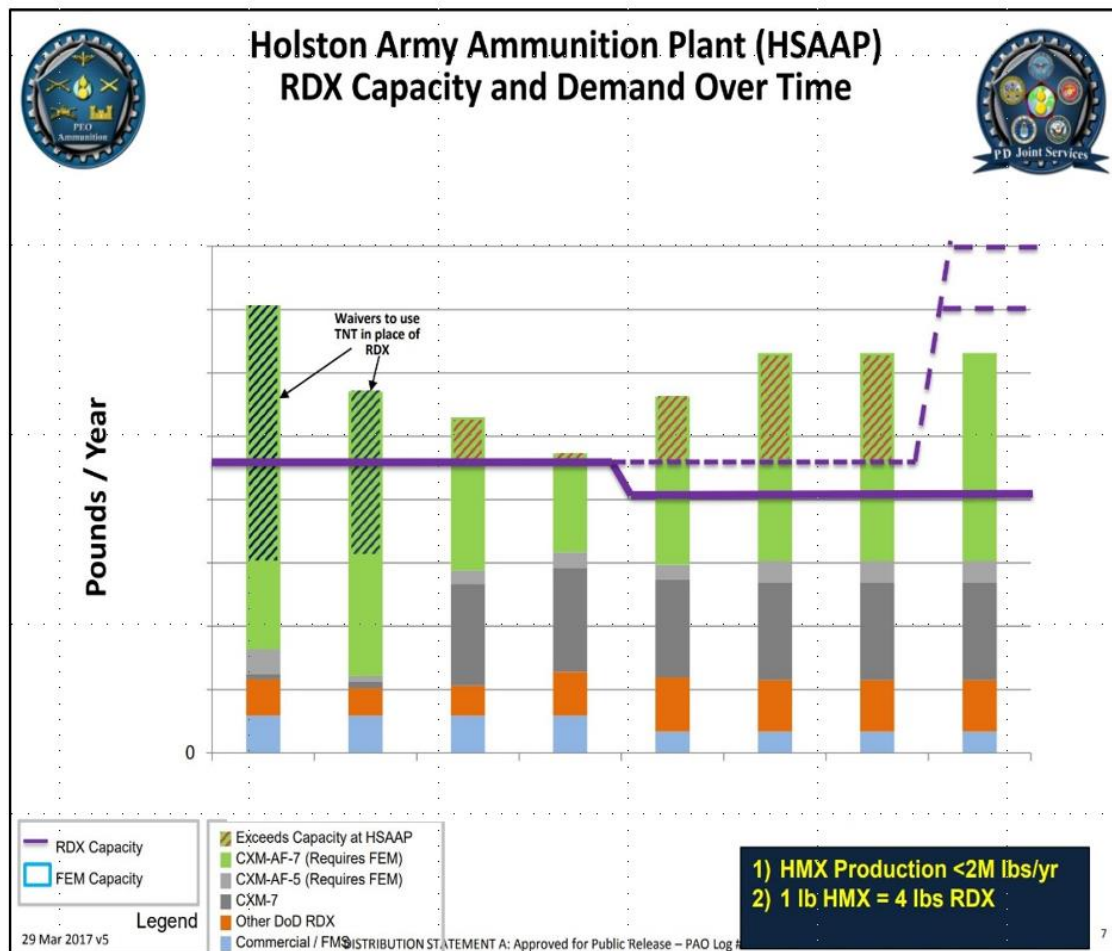


Main Priorities & Challenges

1. Modernizing Without Disrupting Production
 - PB19 adds \$1.25B over FY19-23 for Production Base Support (PBS).
 - Additional tools needed to execute, i.e. Corps of Engineers and /or direct to an Architecture / Engineering Firm
 - Articulation of full PBS requirements to HQDA
2. Execute HSAAP Explosives Capacity Increase

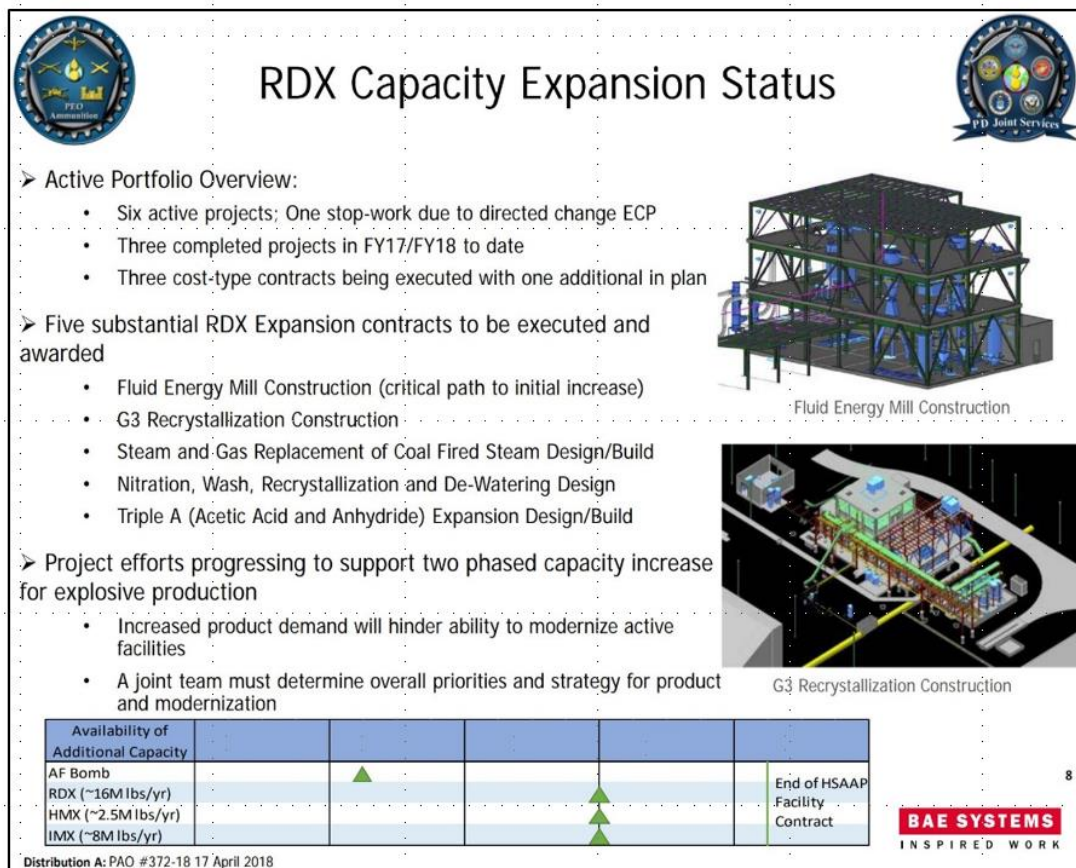
Source: <https://apps.dtic.mil/dtic/tr/fulltext/u2/1050993.pdf>

Backdrop – Driving DoD Demand for RDX, NTO, DNAN, HBD-NQ, Others



Ref. <https://ndiastorage.blob.core.usgovcloudapi.net/ndia/2017/mes/PMZimmerman.pdf>

Backdrop – Production Capacity Expansion via HSAAP Modernization



- Need more of everything
 - RDX, HMX, NTO, DNAN, HBD-NQ etc.
 - Formulations IMX-101, IMX-104, PAX-48 etc.
- Major HSAAP Modernization Programs underway
 - Concurrent with production
- (And an Operating Contract competition)

<http://www.ndia.org/-/media/sites/ndia/meetings-and-events/divisions/munitions-technology/proceedings/final-icap-108-hilton-nj-16-apr-18-distro-a.ashx>

Disruptive Forces: Legacy Chemistry vs Modernization

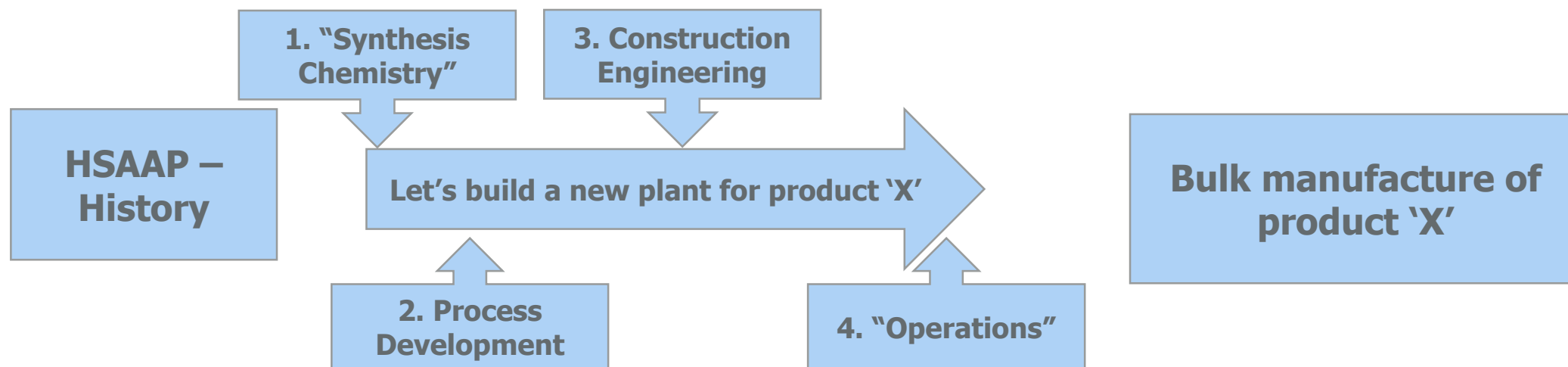
- Legacy chemistry issues that now **must** be addressed during Modernization
 - Better waste stream management – *'yester-year' solutions not available anymore!*
 - Demand for improved product quality (consistency, purity) – *advanced munitions payloads*
 - Demand for greater manufacturing facility flexibility – *make MORE products in the same equipment*
 - Sole-source material supply risks – *make-buy decisions, and use of alternative materials for legacy processes*
 - Reduction in Energy costs / improved energy recycling – *energy costs now a major cost driver*
- **TIME TO ADAPT – What got us here, definitely won't get us there!**
- **...this means R&D too!**

Impact of Disruptive Forces on OSI's HSAAP R&D Synthesis

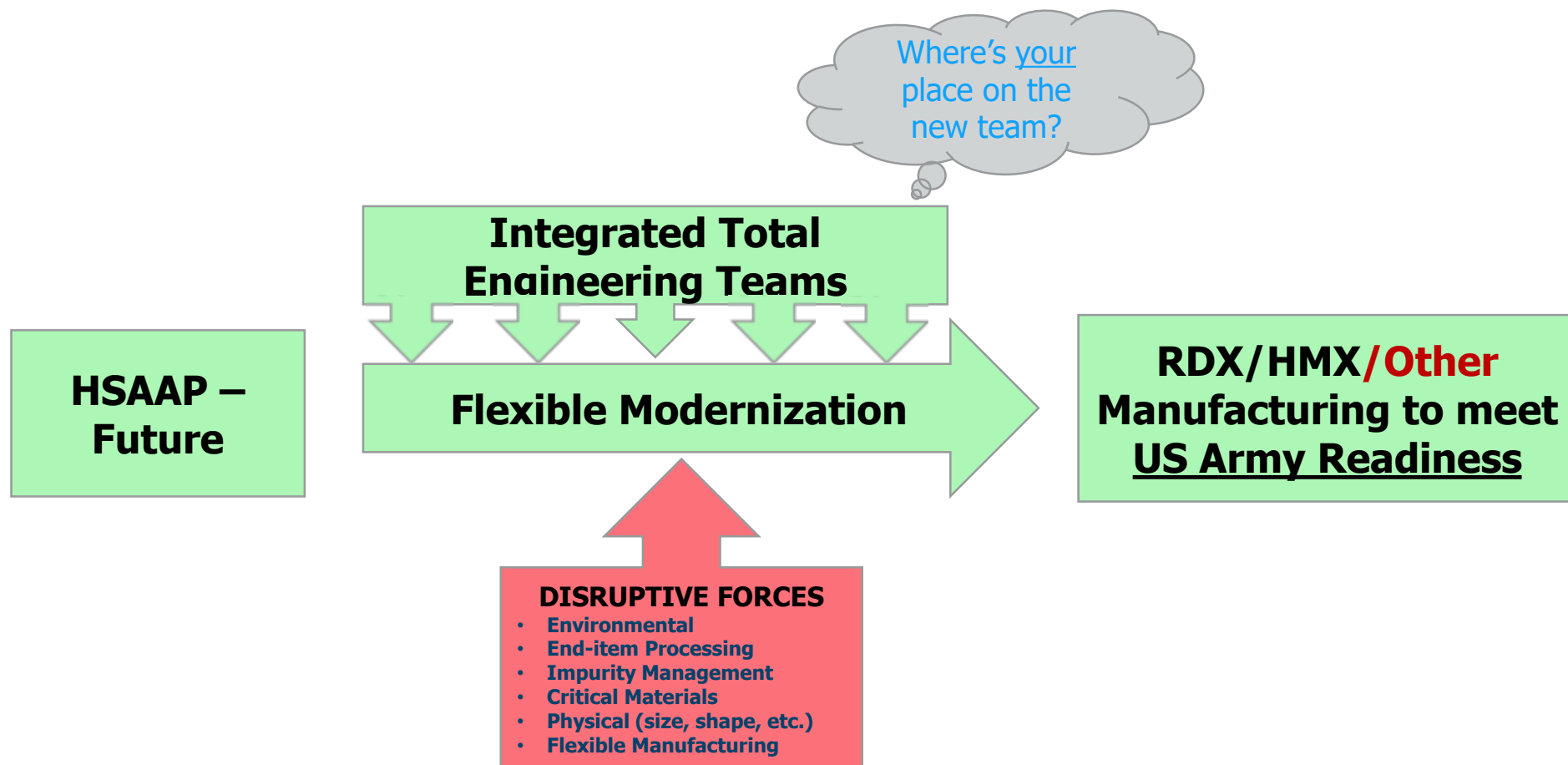
What got us "here", won't get us "there"

- No 'more of the same' R&D solutions for HSAAP energetic materials
- New problems for Synthesis chemists
 - New methods for solvent recovery, stripping/purification, re-use
 - Alternative synthetic chemistry methods
 - Evaluation of alternative raw materials as input chemicals
 - Greater consideration of end-user processing on Holston produced material
 - FEM, Nano-milling, 'RAM'; all bring their own raw-material nuances
 - Greater process instrumentation and automation
 - Greater impurity profiling and analytical scrutiny – we see more now, and it's not all good!
 - 'Same equipment, different product' mentality
- Time for an Integrated R&D Modernization Strategy, where R&D becomes part of...
 - **A Total Engineering Team**

HSAAP Chemistry – our Past: Steps 1-2-3-4



HSAAP Chemistry – our Future: Addressing the Disruptive Forces as ONE TEAM

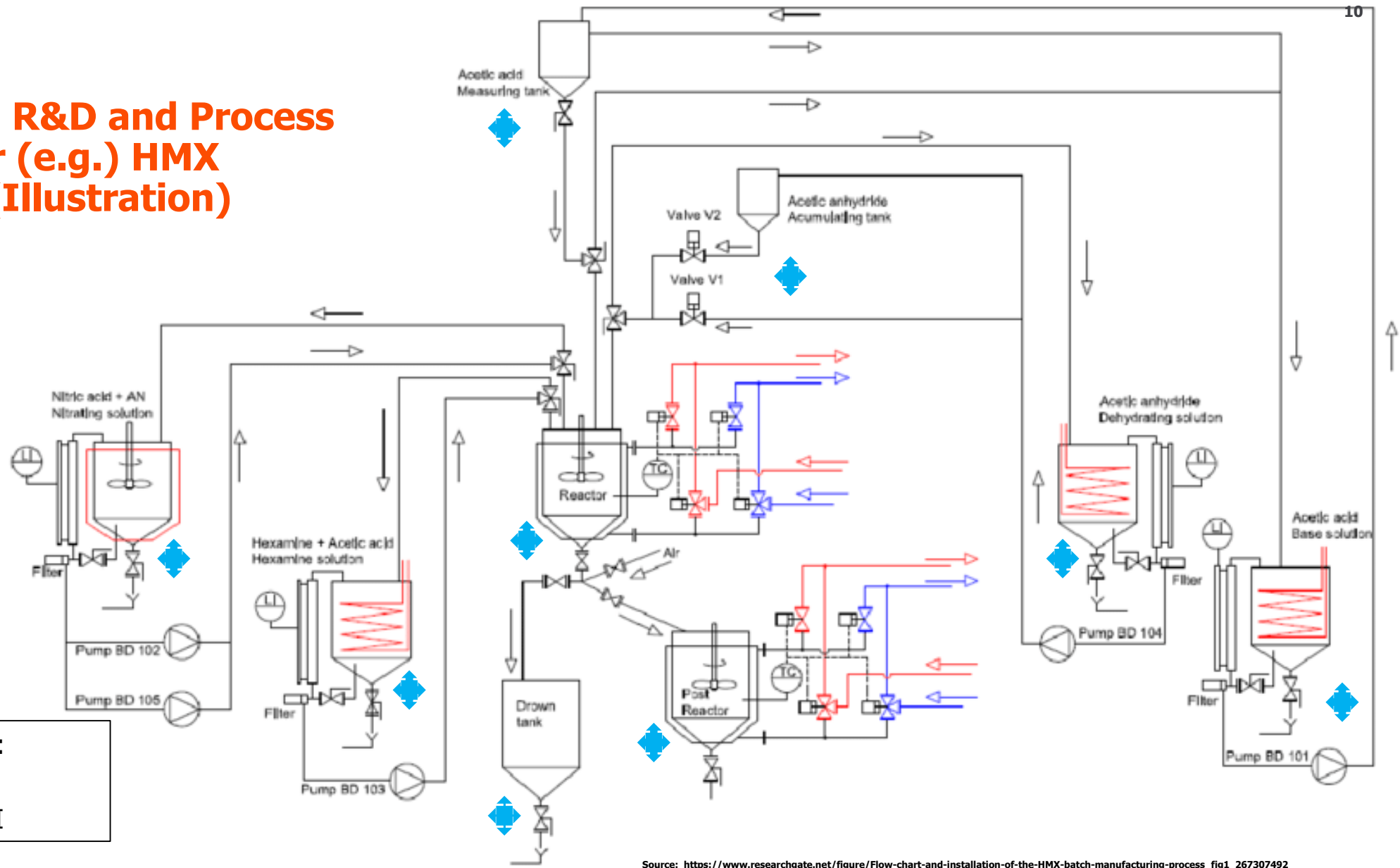


Traditional OSI R&D and Process Engineering for (e.g.) HMX Improvement (Illustration)

Note: R&D Synthesis does not usually participate in Nitration Continuous Improvement ('CI') – no 'red diamonds' in the plant!

Key (traditional focus area):

- ◆ – R&D Synthesis CI
- ◆ – Process Engineering CI



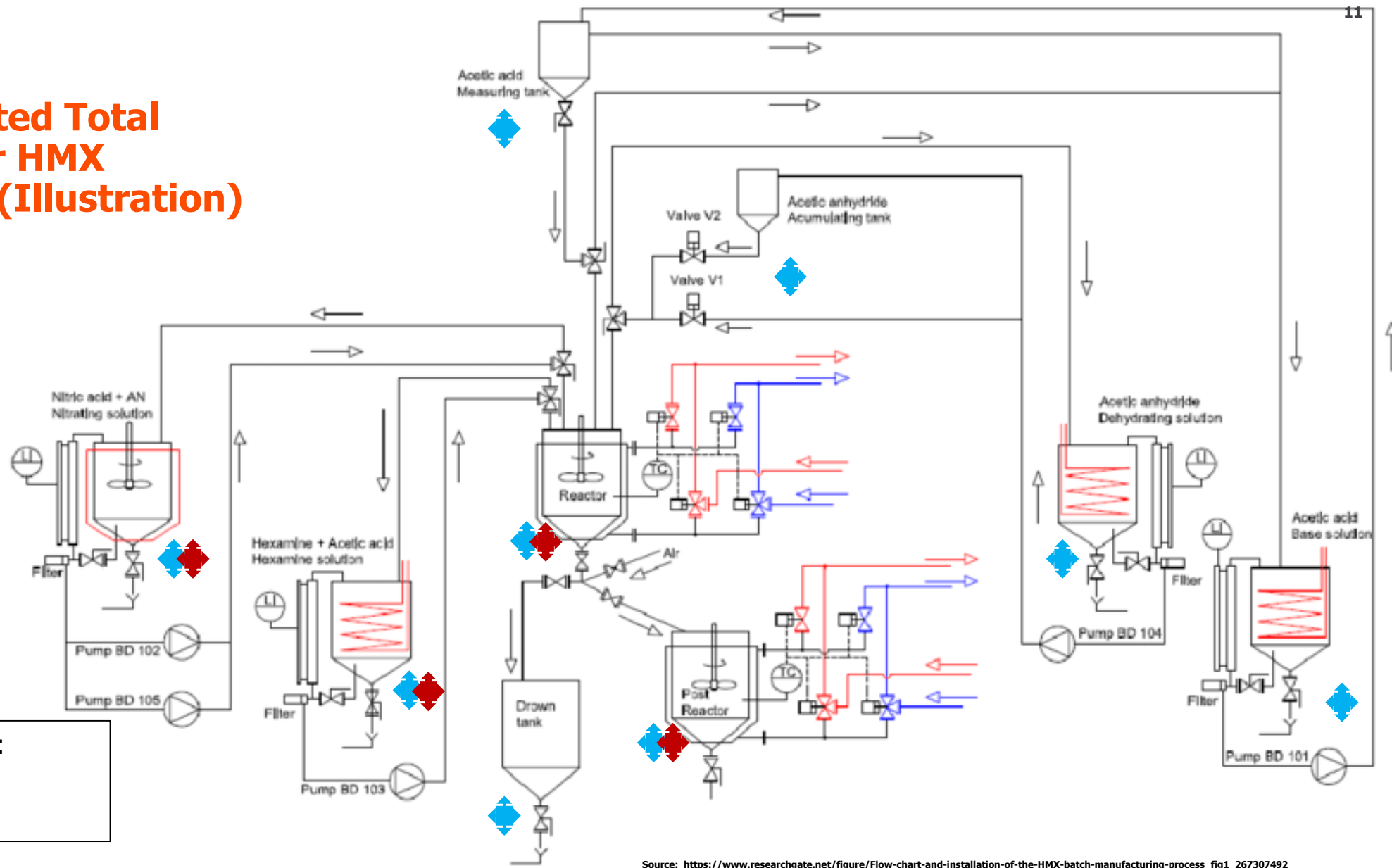
Source: https://www.researchgate.net/figure/Flow-chart-and-installation-of-the-HMX-batch-manufacturing-process_fig1_267307492

Future Integrated Total Engineering for HMX Modernization (Illustration)

Note: R&D Synthesis to play a greater role for Modernizing – more than for a usual 'scale-up' program

Key (traditional focus area):

- ◆ – R&D Synthesis
- ◆ – *Other Engineering*



Source: https://www.researchgate.net/figure/Flow-chart-and-installation-of-the-HMX-batch-manufacturing-process_fig1_267307492

What might this mean for Industry R&D for Military Explosives

- It's time for Western World military explosives legacy chemistry to evolve
 - The methods of yester-year are increasingly not adequate for today's military Readiness mission
- Military Explosives R&D needs greater alignment with Engineering and Manufacturing to remain relevant
 - New/improved methods for legacy products to improve material, energy, waste-stream and quality issues
 - Stronger R&D integration with Continuous Improvement initiatives for chemical products/processes
 - Greater up-front involvement with Modernization Engineering for chemical process scale-up
- **R&D integration – part of a Total Engineering Team**
 - Jointly address the disruptive forces that impact “legacy chemistry” and slow the pace of change

Summary

- Legacy chemistry METHODS and practices are simply not good enough for the modern age
- Need to be better positioned to respond to military Readiness requirements
- Many drivers for change
 - Advanced ammunition payloads require different physical forms of our legacy materials;
 - Better understanding and smarter control of impurities to aid modern processing techniques (nano, RAM etc.)
 - Greater consistency (e.g. particle size distribution, batch-to-batch variation)
 - Environmental regulatory compliance
 - Energy consumption
 - Multi-product, flexible manufacturing capabilities are INCREASINGLY desirable
 - Elimination of sole-source or critical material issues
- **R&D Chemists to become part of an Integrated Total Engineering Team**

Thank you!

- Acknowledgements to:
 - OSI R&D Personnel (J. Morris, M. Ervin, C.Teague)
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