



TSE Processing of PBXN-111 Explosives

14th Continuous Mixer and Extruder
Users Group Meeting
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Objective

- Compare PBXN-111 processed in a vertical batch mixer to material processed in a TSE
 - Underwater performance (quarry testing)
 - Chemical and mechanical properties
- Manufacture PBXN-111 on a 40-mm TSE
- Load two twenty pound generic warheads

Approach

- Review historical IHDIV TSE HTPB processing work
 - PBXW-128
 - SNPE 6818
- Obtain ingredients from Yorktown (same lots)
- Make one pint vertical mixes
 - Potlife/Cure Time
 - Safety Data
- Preblend ingredients
- Install aluminum slurry liquid feed system
- Conduct liquid pump / solid feeder accuracy testing
- Conduct 40mm TSE processing trials
- Cast two test charges and pan samples (“standard” procedure)
- Conduct quarry and mechanical properties testing

Formulation

Ingredient	Function	Weight %
Solids		88.00%
RDX, Type B, Class 1	Explosive	
RDX, Type B, Class 5	Explosive	
Ammonium Perchlorate	Oxidizer	
Aluminum	Fuel	
Binder		12.00%
R45	Polymer	
IDP	Plasticizer	
E-702	Anti-oxidant	
IPDI	Curative	
Triphenylbismuth	Catalyst	

Feed Streams

Feed streams	Preblend?	Feeder
RDX Blend	V-Cone	C&M HD-12
AP	No	K-Tron T-37
Aluminum Slurry (Al, IDP, R45, E-702, TPB)	Cowles Dissolver	Moyno Slurry Pump
IPDI/IDP	Stock Pot	Zennith Gear Pump

Feeder Testing

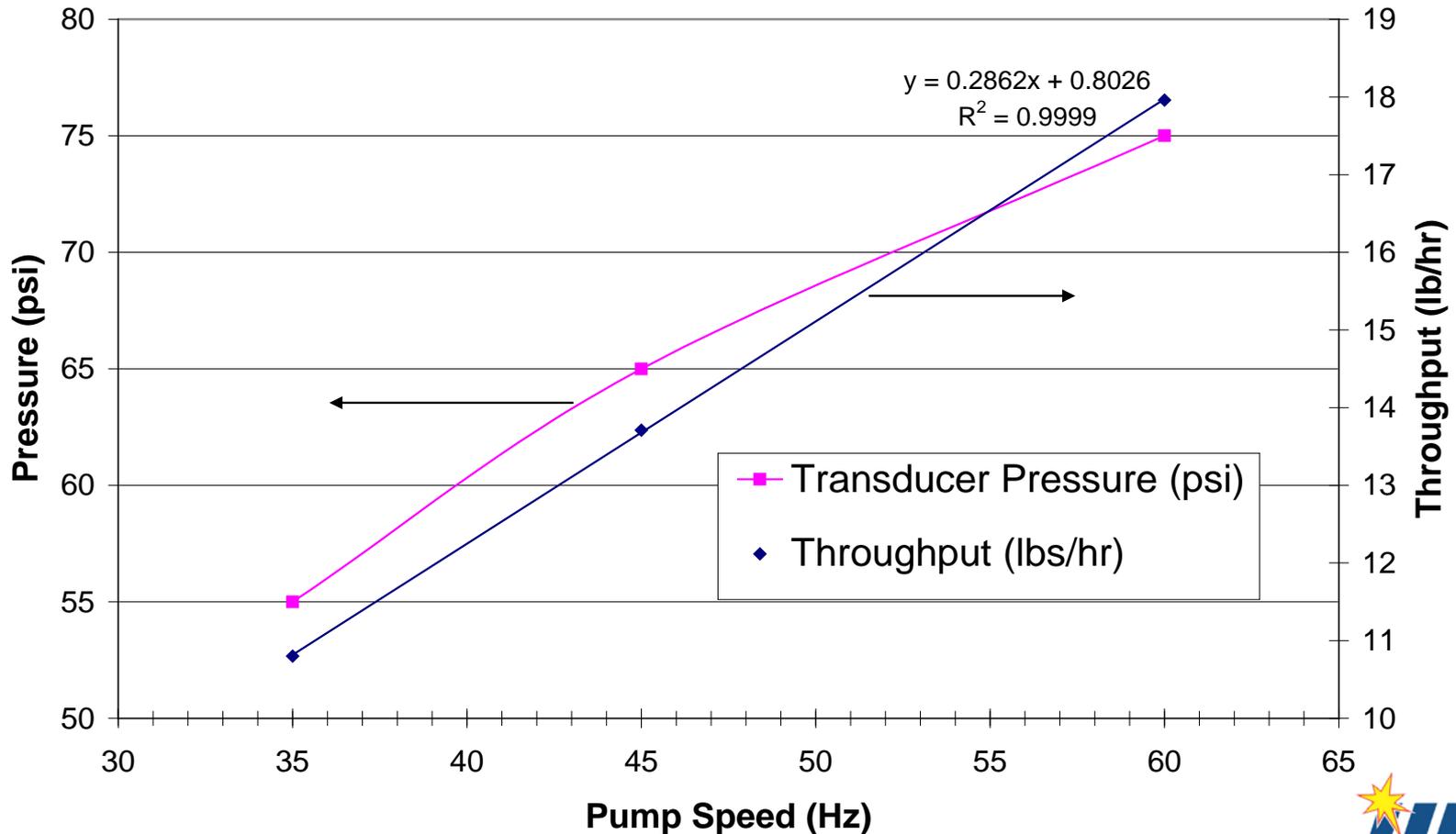
Set Point (lb/hr)	Actual (lb/hr)	±Target wt%	15s Coefficient of Variation	60s Coefficient of Variation	Amount in Hopper (lb)
7.00	6.98	-0.29%	0.05	0.03	21
8.00	8.18	2.25%	0.06	0.02	40
10.00	10.04	0.40%	0.05	0.03	30

	RDX Class 1	RDX Class V	RDX Blend	Blend After 1 Hour of Agitation	Blend After 2 Hours of Agitation	Blend After 3 Hours of Agitation
SRA @ 10%	64.1	9.1	13.5	12.5	13.5	14.1
SRA @ 50%	165.5	21.4	49.9	45.3	48.4	51.3
SRA @ 90%	292.1	41.2	230.0	227.5	192.4	224.6
SRA Mean Value	172.4	23.7	93.4	90.7	76.3	90.8

No RDX Segregation

Feeder Testing

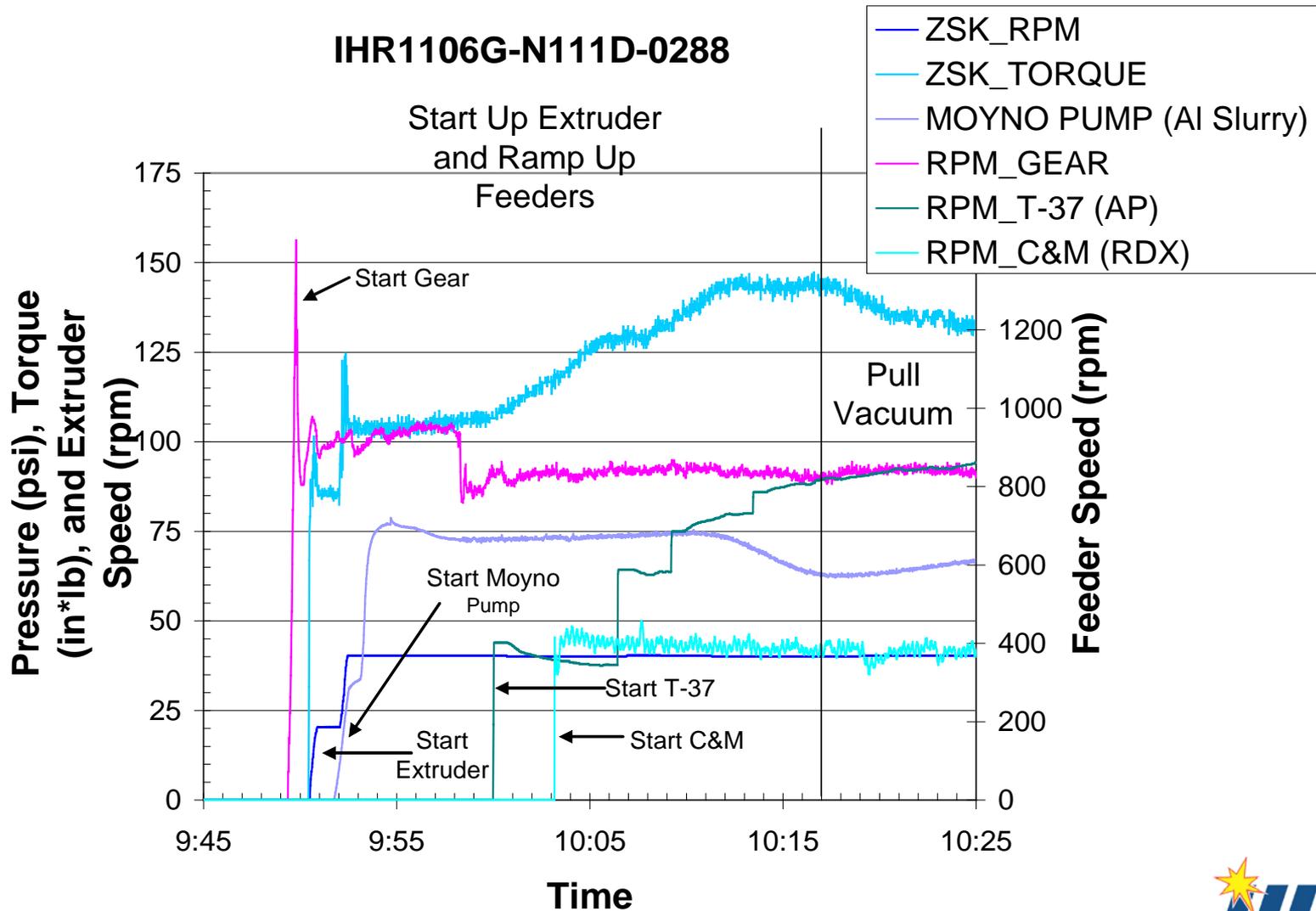
Moyno Pump Calibration Curve



40mm W&P TSE Processing Trials

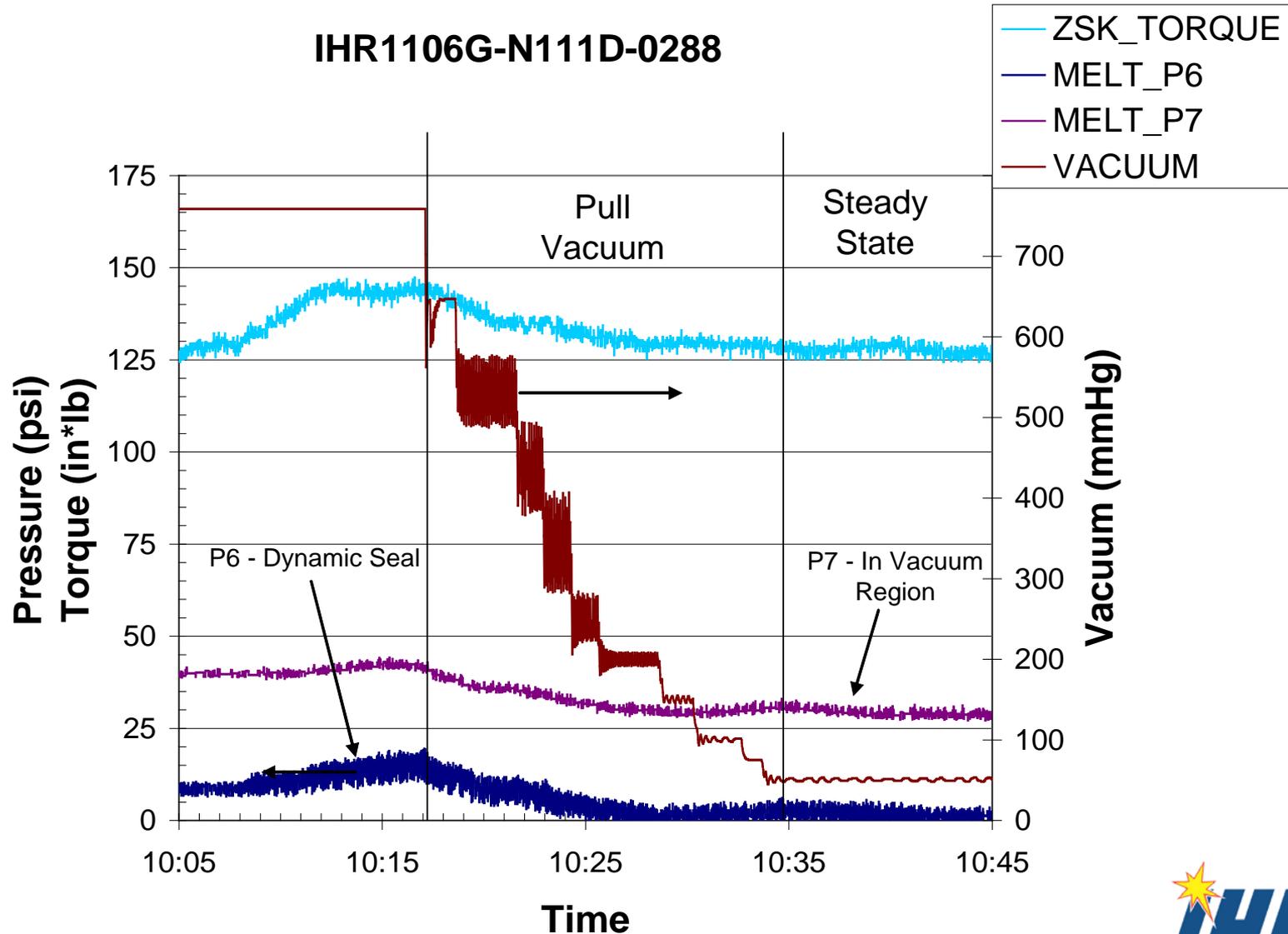
- Conducted 3 TSE full processing trials
 - Varied throughput, screw speed, and screw design
 - Two aborted trials:
 - Equipment and Facility Issues
 - Final Processing Trial:
 - Manufactured over 100 pounds of material for casting

Feeder Ramp Up Data



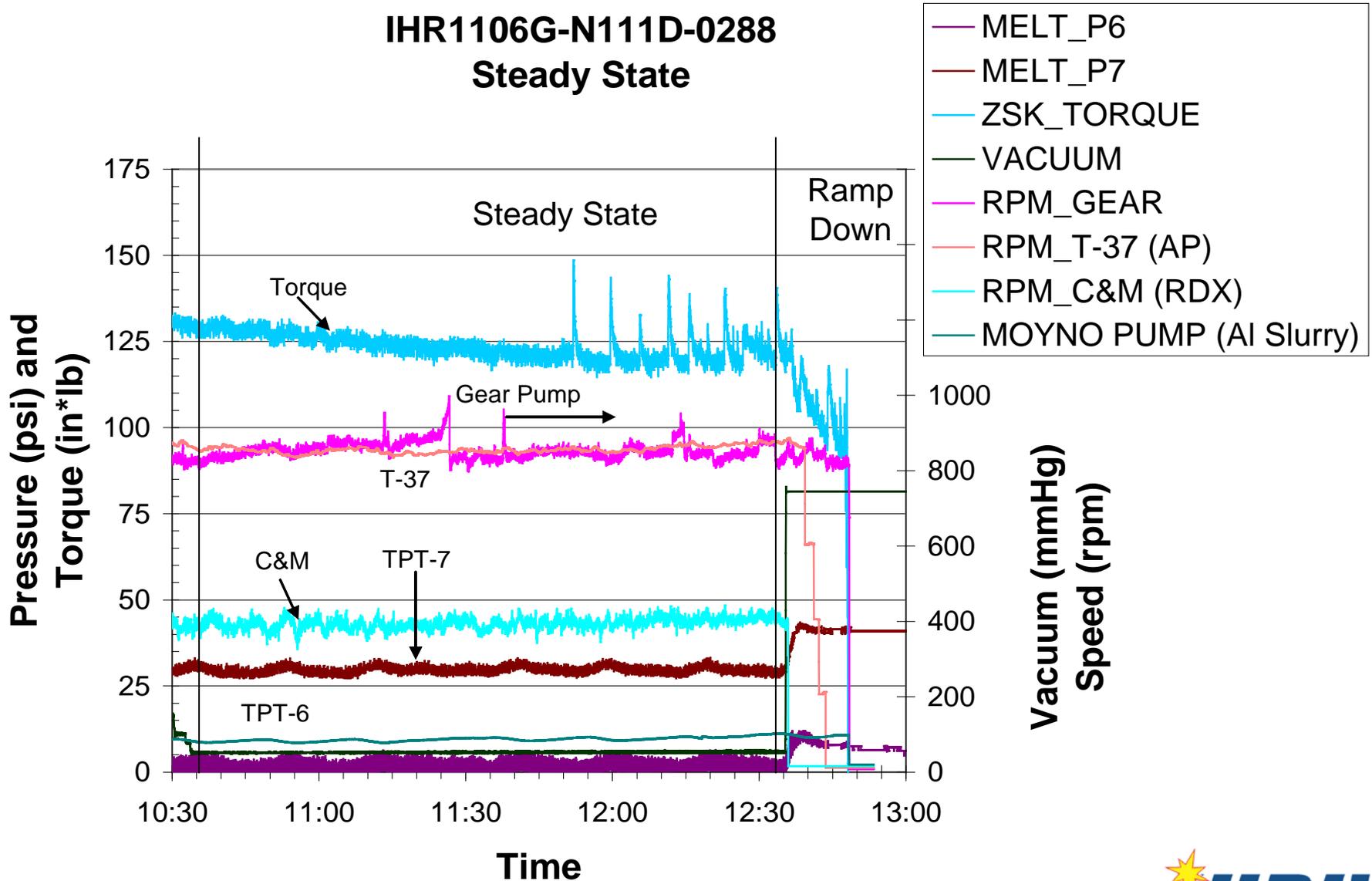
Applying Vacuum

IHR1106G-N111D-0288



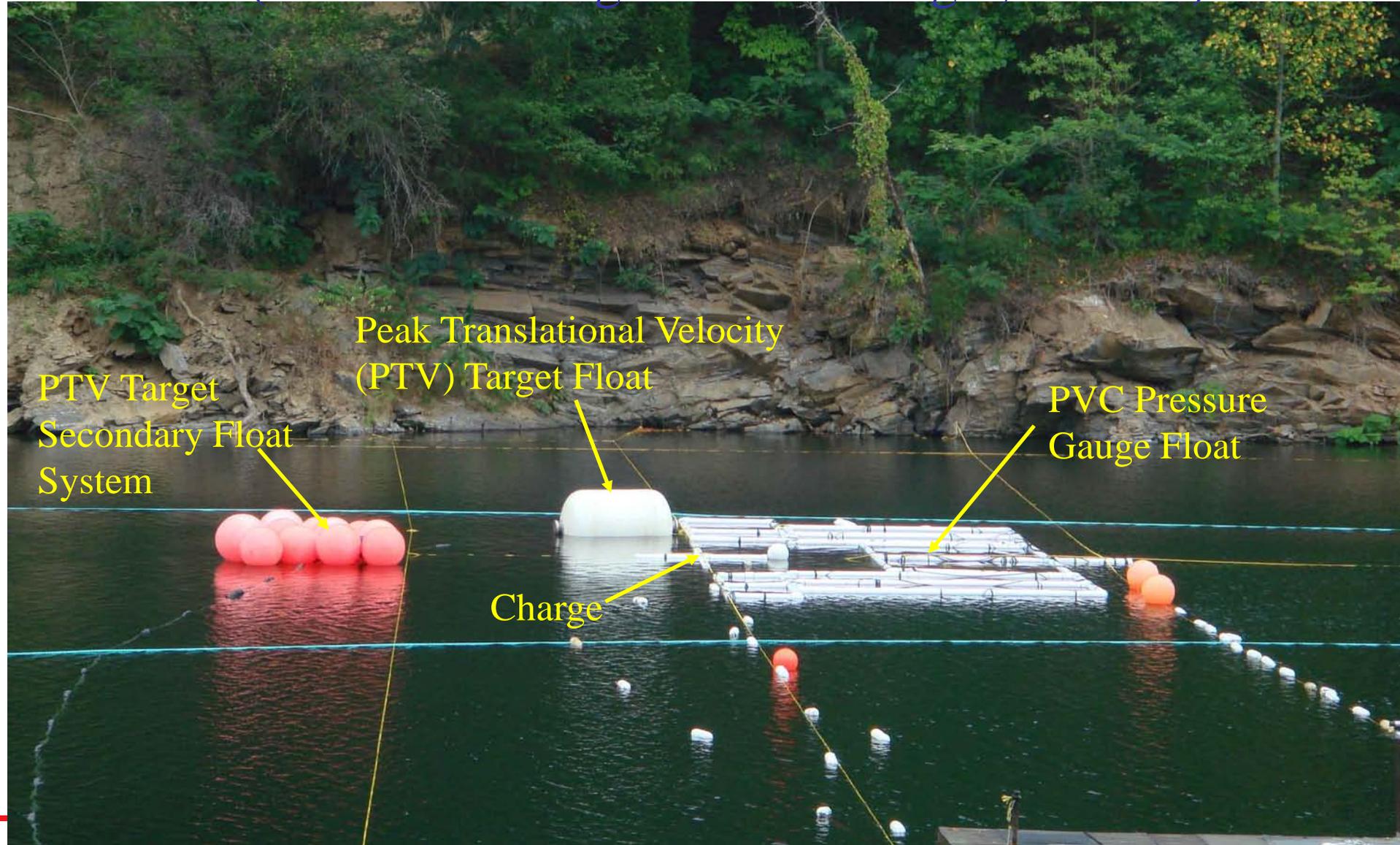
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Steady State



Test Layout

(Free Field Gauges & PTV Target, all tests)



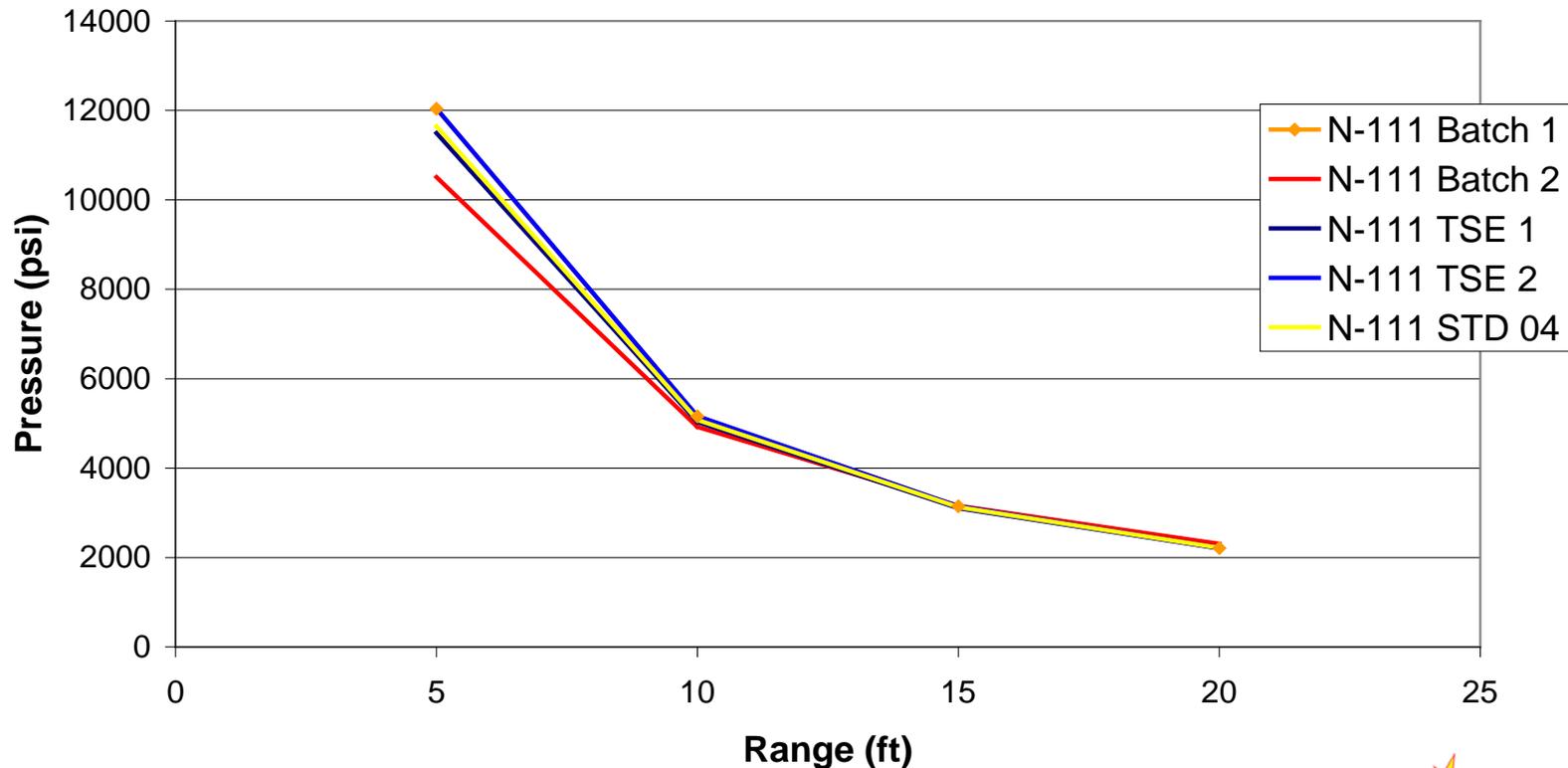
Quarry Testing



Distribution Statement A: Approved for Public Release, distribution unlimited

Quarry Test Results

Range vs Pressure



Quarry Test Results

Preliminary

	Test	N111 Wt (lb)	Pmax	En-1	En-5	Im-1	Im-5	RBE
Batch	6251	21.45	1.024	0.988	1.016	0.991	1.013	1.023
	6252	21.40	1.004	1.000	1.012	1.027	1.005	n/a
Twin Screw	6261	20.82	0.967	0.960	0.991	0.978	0.991	1.008
	6262	20.92	1.001	0.975	0.999	0.984	0.985	0.999

20 pound charge, 15 foot range using calculated similitude parameters

EQUIVALENT WEIGHT RATIO FOR EQUAL EXPLOSIVE EFFECTS

Chemical & Mechanical Property Results

Property	Min.	Max.	Batch Explosive	TSE Explosive
Density, g/cc	1.74	1.82	1.78	1.74
Stress (max)., psi	40	---	71.9	47.6
Strain , max. stress	8	---	12.5	12.3
Shore A Hardness, 15 s	20	---	40	35
Vacuum Stability at 100C (mL gas per g per 48 hrs)	---	0.5	0.14	0.12
% Solids	86	89	88	Note 1

Note 1: Yorktown unable to perform test on cured explosive.

Conclusions

- Successfully and safely processed PBXN-111 in the 40mm TSE within a short time frame (12 weeks from program start, 8 weeks from ingredient receipt)
- Loaded two 20-lb test charges and sample pans
- TSE material within specification – low end of density (vacuum level?) and stress
- Tested two TSE manufactured test charges at quarry
- Preliminary results indicate that TSE processed PBXN-111 is equivalent to batch processed PBXN-111

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