



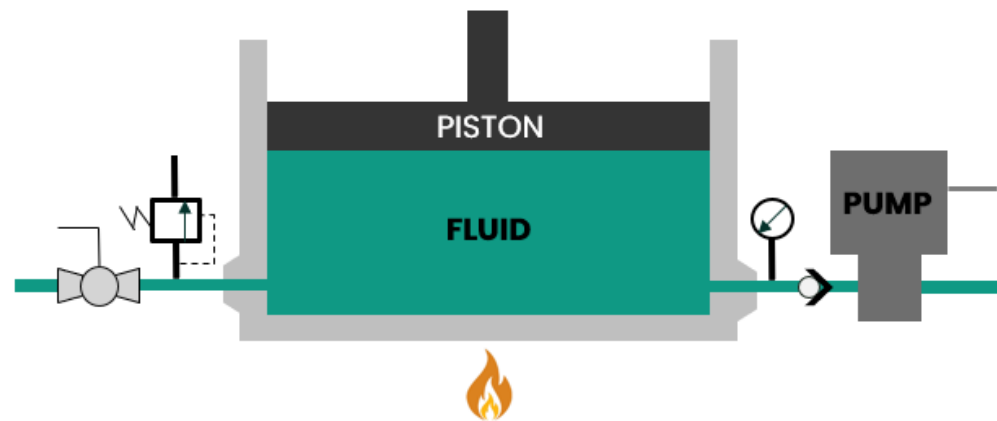
2022 COS FORUM

Pressure Risk Management - Barrier Selection Tool

Abel A. Gloria, P.E. – High Hazard Engineer,
Baker Hughes

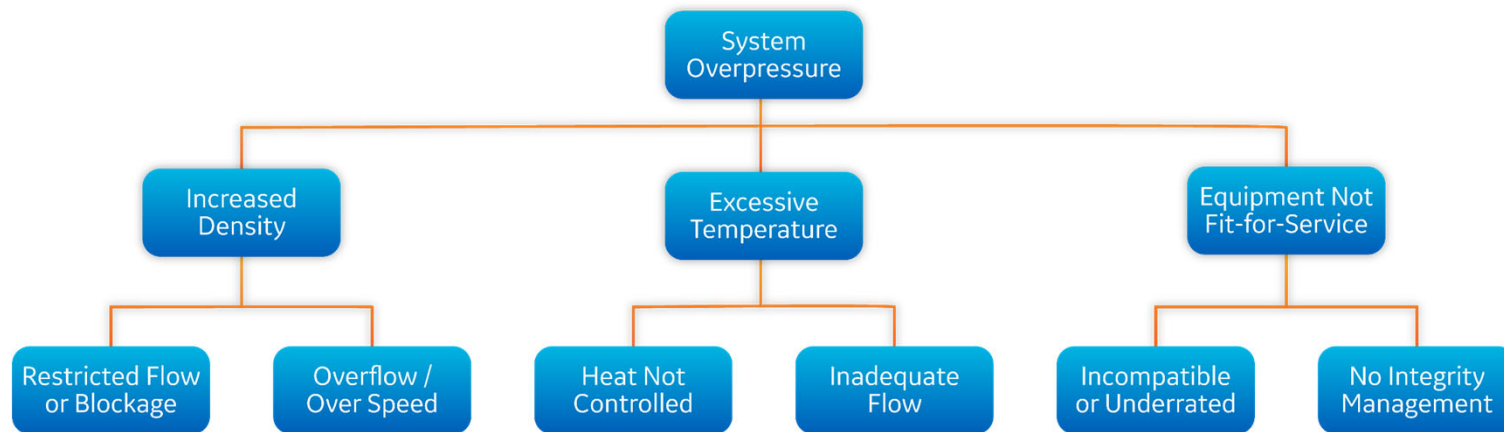
Fluid Pressure

1. Applying heat to a fluid in a closed system, or at constant volume
2. Decreasing the volume of a fluid while its mass remains constant
3. Increasing the mass of a fluid while its volume remains constant



NOTE: Equipment intended to hold fluid pressure will receive transferred energy by work, or external forces and pumps, and/or by heat. Once energized, its energy is awaiting to be transformed or transferred out to another system.

The Origins of System Overpressure!



Engineering: System engineering and Life Integrity Mgmt.

Quality: Assurance standards to maintain system integrity

Compliance: to industry standards & regulatory req.

Verification: and validation of function as designed.

Parameter Control: and monitoring of system parameters.

MIT: Maintenance, Inspection, and Testing program.

PSSR-ESD: Start-up, testing and shut-down procedures.

Safety Functions: Pressure limiting devices & controls.

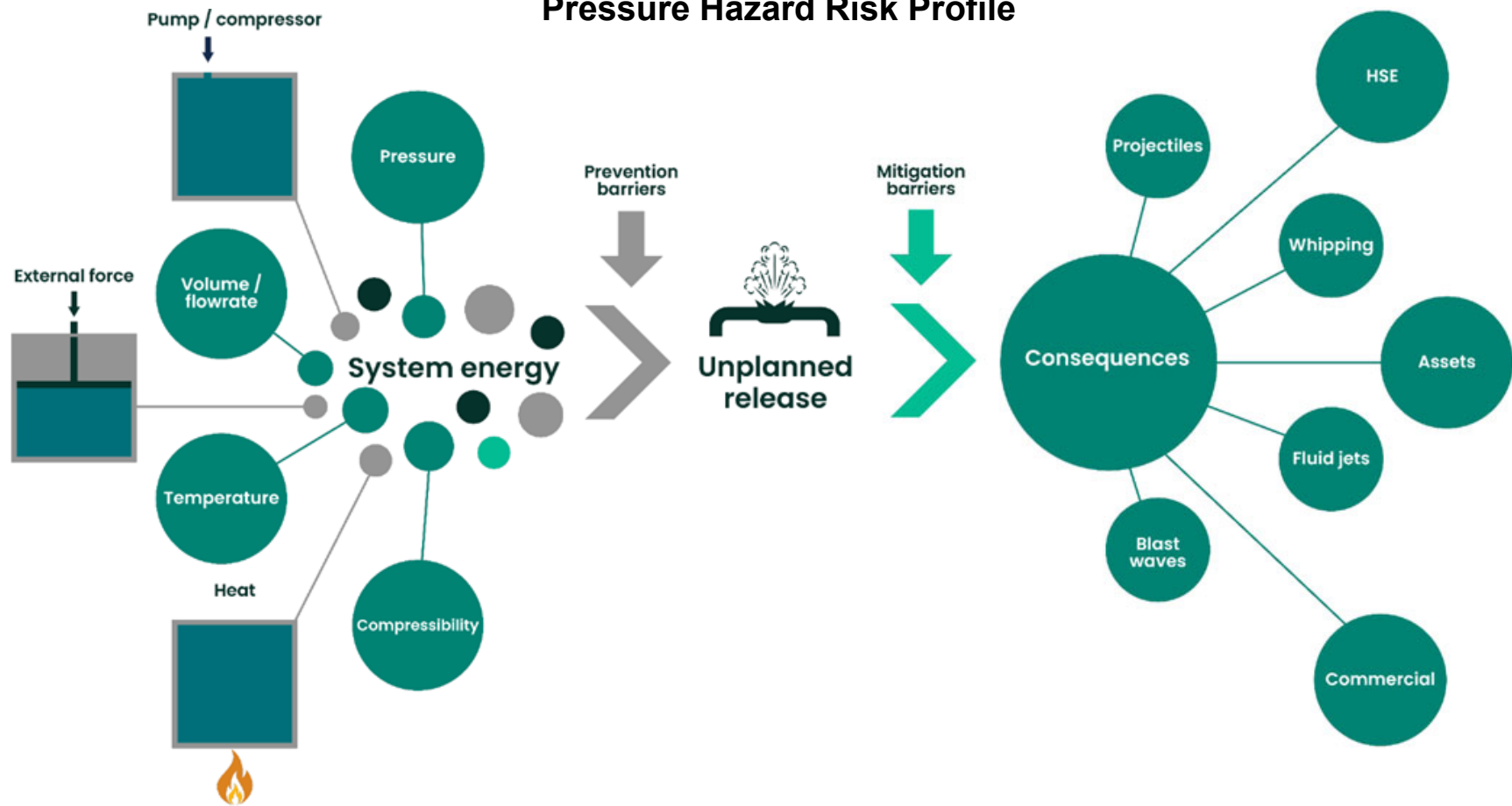
Personnel: Qualified and competent to perform critical tasks.

Operational Discipline: Procedures with verifications checks.

RA: Risk assessment completed and communicated.

Traditional Pressure Risk Management Controls

Pressure Hazard Risk Profile



Pressurized Equipment Failure



WHY?

*Overpressure:
Incompatible
Equipment*

*No Account for
Pressure Energy in
Mitigation Barrier*

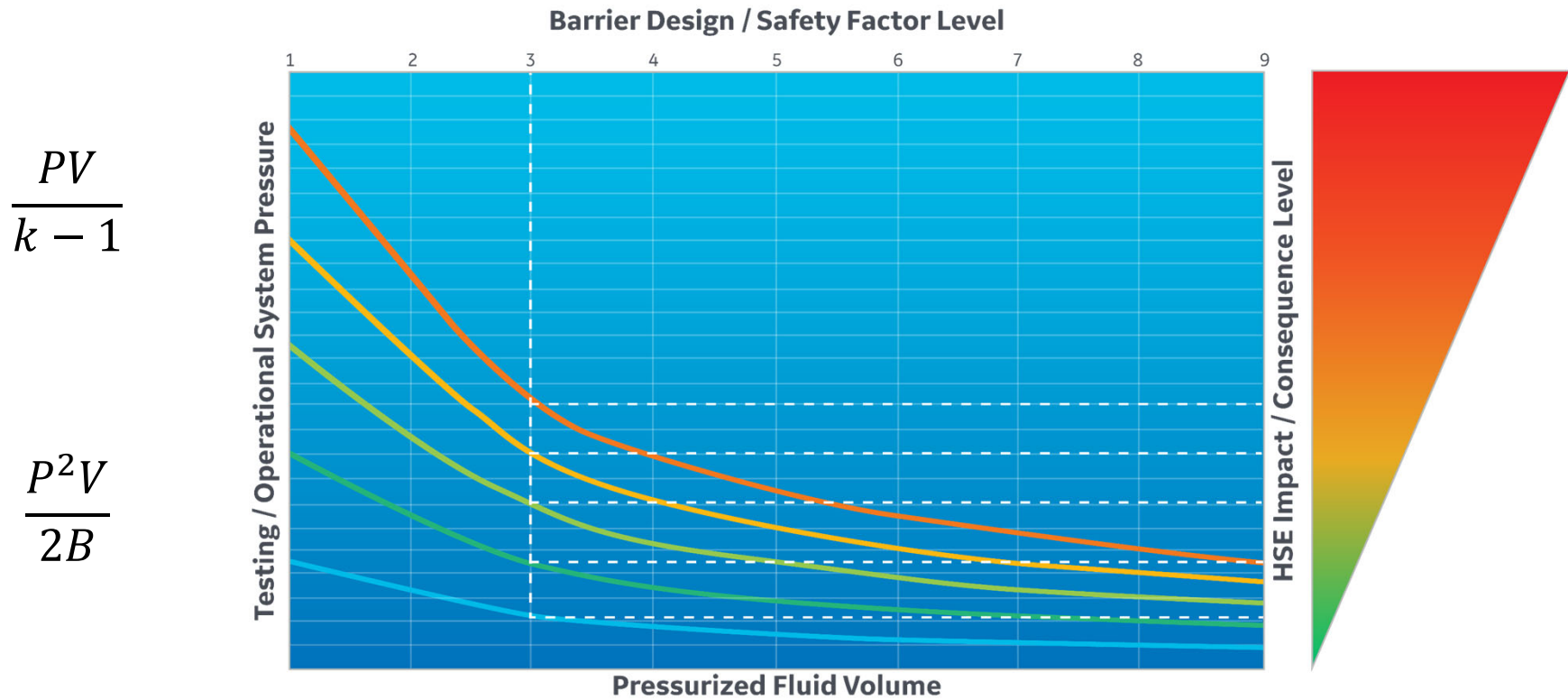


9 5/8" oilfield tubular assembly pressure test

- Hold 7530-psi for 15-minutes
- Connection failure occurred at ~ 6000 psi
- Parted tubulars ejected towards each end of this test bay.
- Test bay was not designed to contain projectiles associated with unplanned release of energy.

Common Dangerous Hazards

- Projectiles
- Fluid Jetting
- Whipping
- Blast Waves



Presented at IADC Drilling HSE&T Europe 2019 Conference & Exhibition

PEBRAD

- Precision and consistency for risk assessors
- Recognize pressure hazard severity
- Implement energy-based barriers
- Manage catastrophic potential
- Achieve acceptable risk levels

PRESSURE ENERGY BARRIER & RISK ASSESSMENT DIAGRAM

Water SELECT FLUID TYPE

PRESSURE (PSI)	VOLUME (CF)
15,000	10

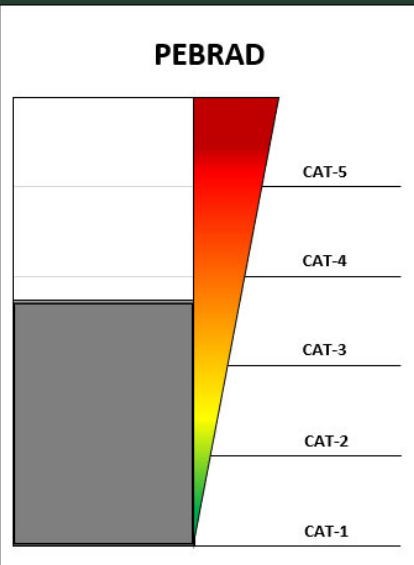
CAT-1:
Implements effective prevention and mitigation barriers, or safeguards, in accordance with the Pressure Safety - Testing Procedure.

CAT-2:
CAT-1 + Identify overpressure initiating conditions or threats that can lead to loss of pressure energy containment.


CAT-3:
CAT-2 + Conduct system analysis on equipment specifications and operating conditions using an approved risk-based engineering plan.

CAT-4:
CAT-3 + Demonstration of risk reduction controls and monitoring systems capable of mitigating high energy releases including environmental impact.

CAT-5:
CAT-4 + Establish an approved emergency response plan and recovery readiness protocol.



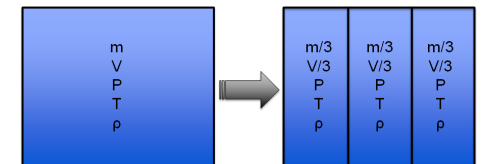
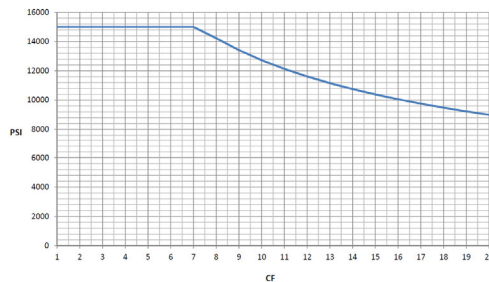
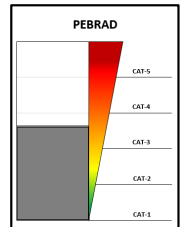
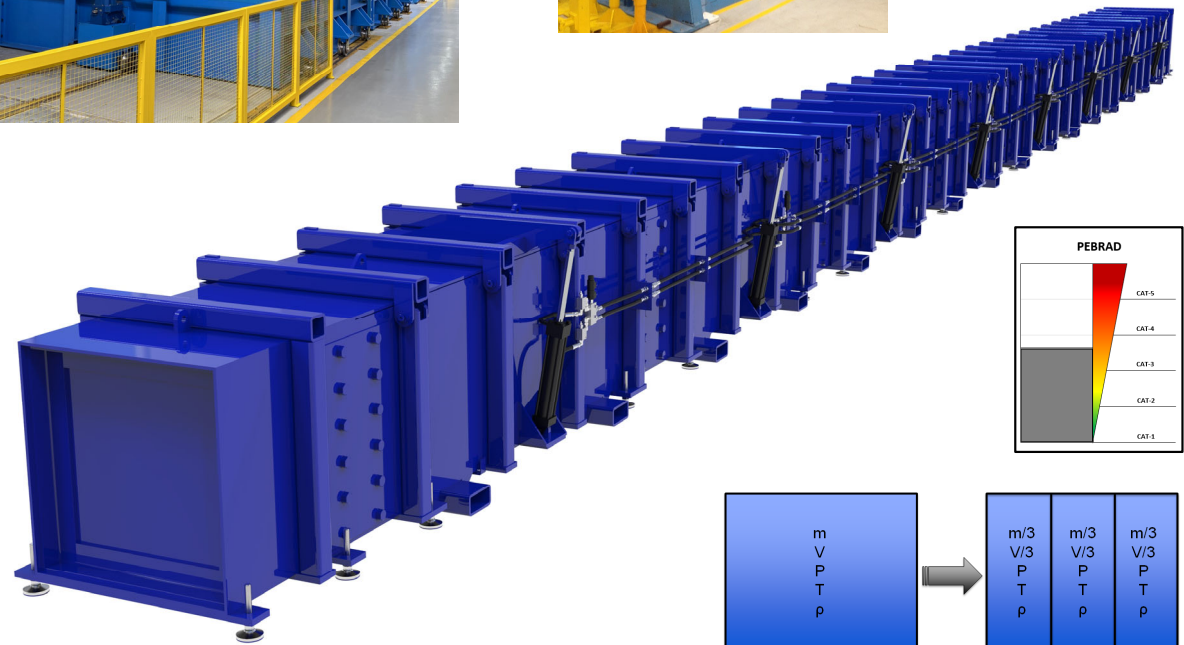
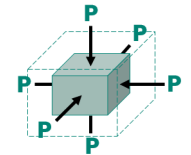
PEBRAD



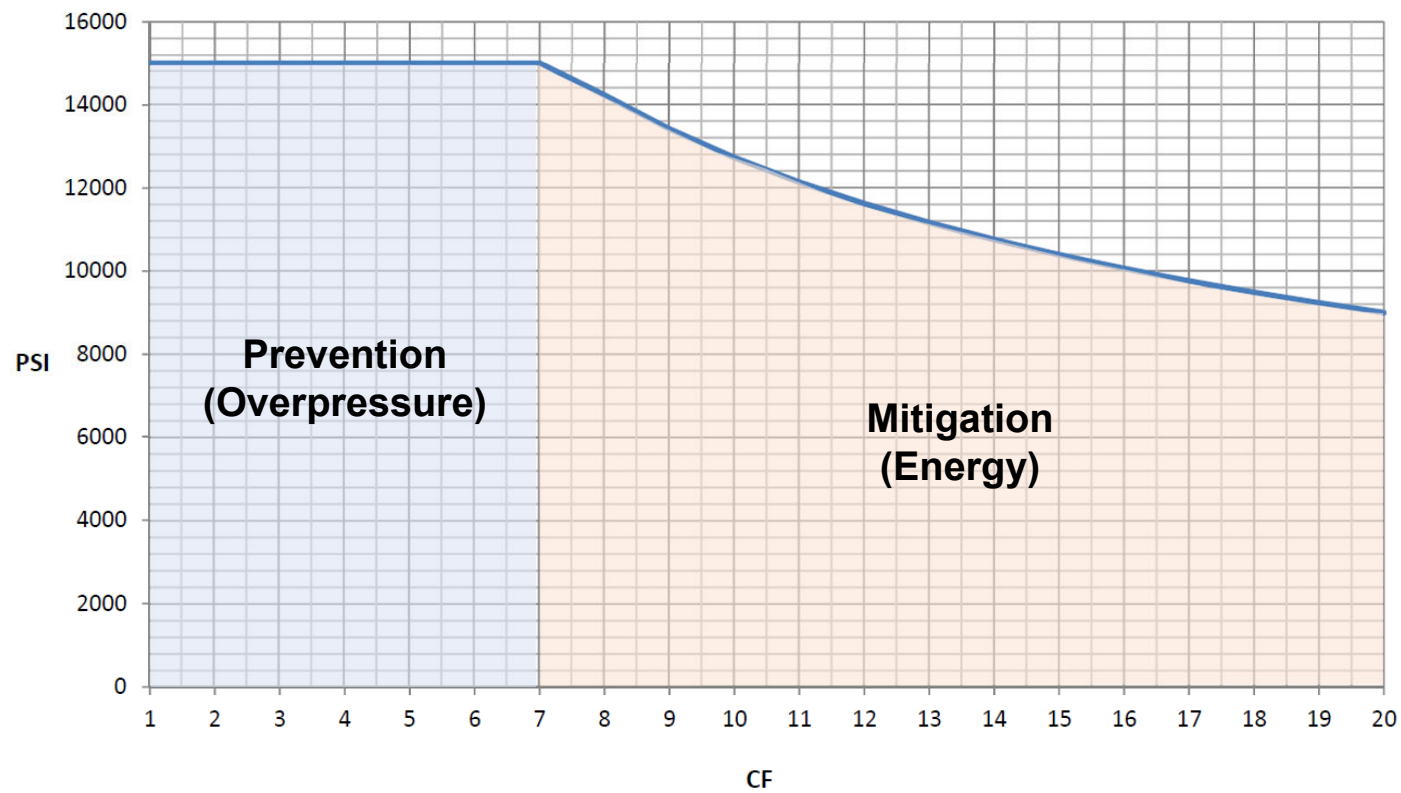
© 2020 Baker Hughes Company. All rights reserved.

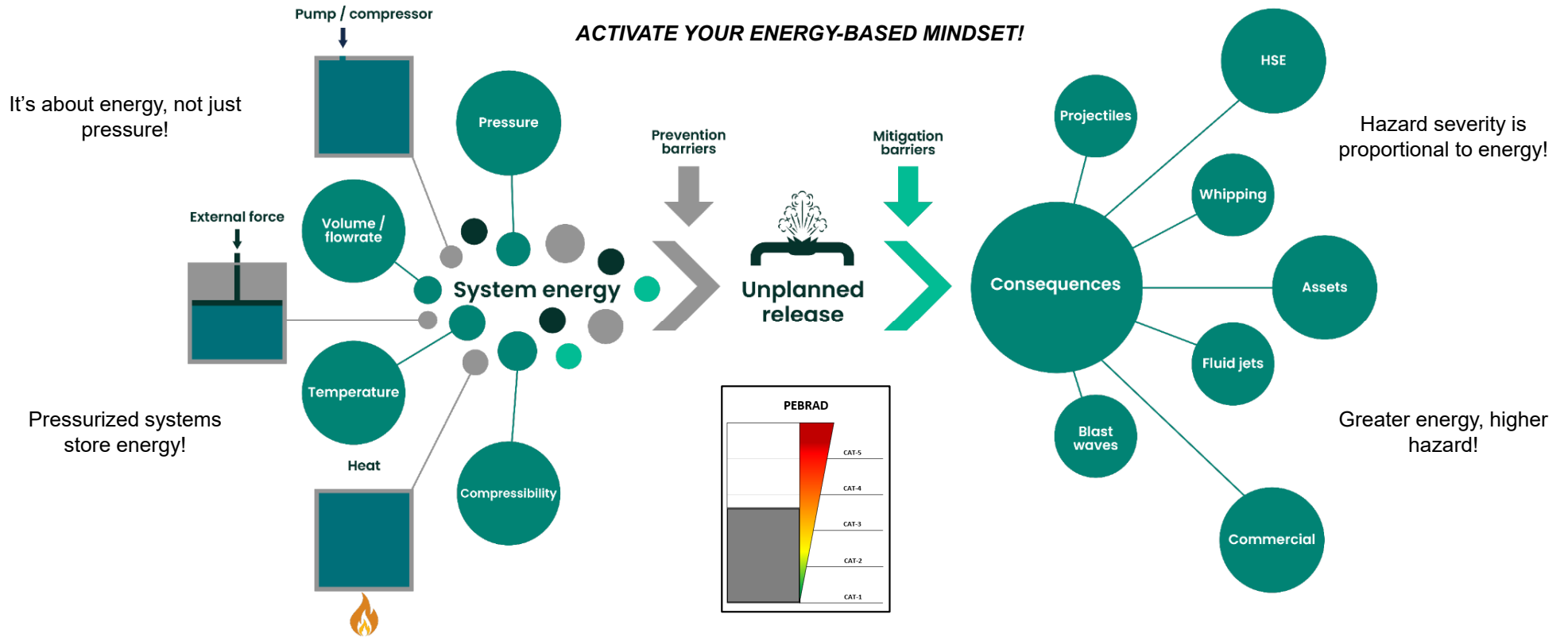
Mitigation Barriers

- PEBRAD - Recognizing Hazard Severity
- Fit-for-Purpose Protective Structures
- Volume-reduction Measures
- Certified & Approved Hose / Line Restraints
- Risk-based Perimeters / Stand-off Distances
- Energy-based Ratings



Energy-based Ratings





Questions?

abel.gloria@bakerhughes.com

| 361-549-5836