King County Council

Independent Assessment of the West Point Treatment Plant

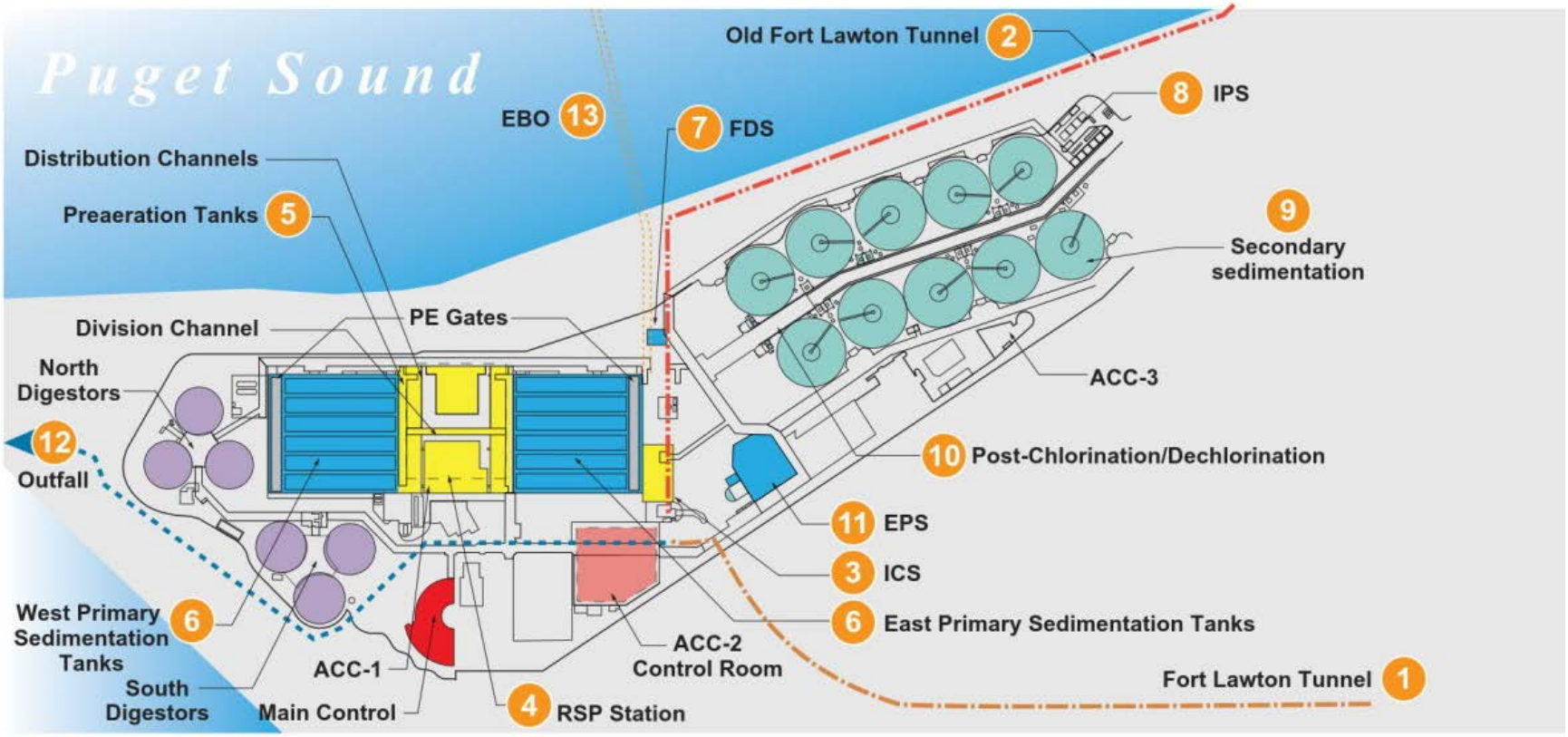
July 18, 2017

AECOM

Presentation

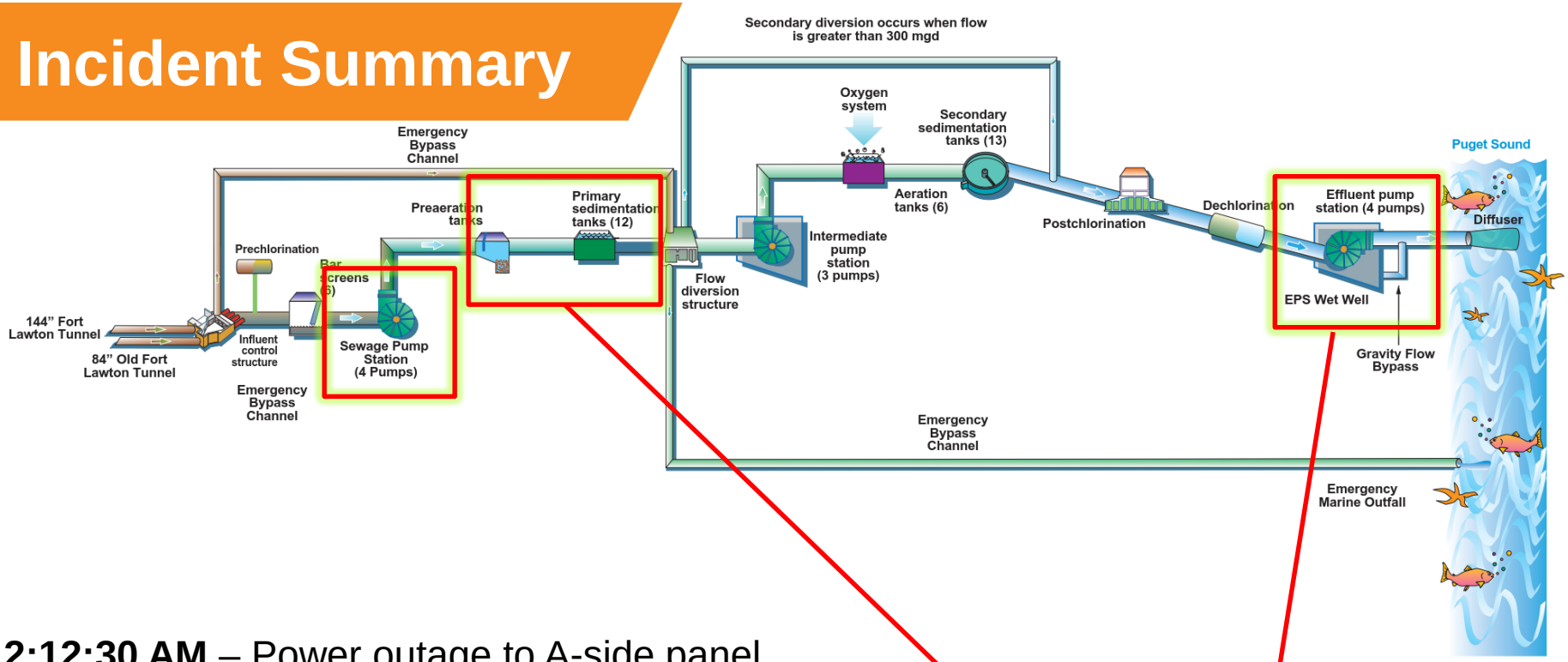
- Background
- Incident Summary
- Investigation Approach
- HAZOP Analysis
- Failure Mechanisms
- Findings and Lessons Learned
- Life Safety Management
- Recommendations

Background

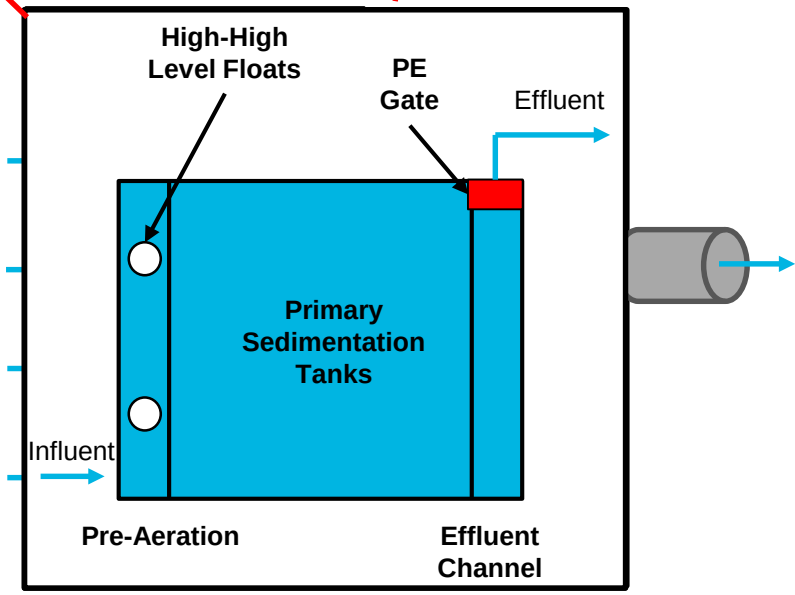


- **Combined sewage treatment plant (stormwater and sewage)**
- **440 mgd capacity primary treatment, 300 mgd secondary treatment**
- **Constrained Site**

Incident Summary



2:12:30 AM – Power outage to A-side panel Pumps 1 & 2 fail; Hydraulic System fails
2:14:40 AM – Pumps 3 & 4 fail
2:14:59 AM – High level alarm in Effluent Pump Station triggers interlock with Primary Effluent gates to close
2:25:00 AM – High-High level floats failed to activate (flooding of WPTP begins)
3:04:00 AM – Raw Sewage Pumps manually stopped; Emergency Bypass initiated
3:05:00 AM – Flooding stops
[2,315 Alarms in 51 minutes]



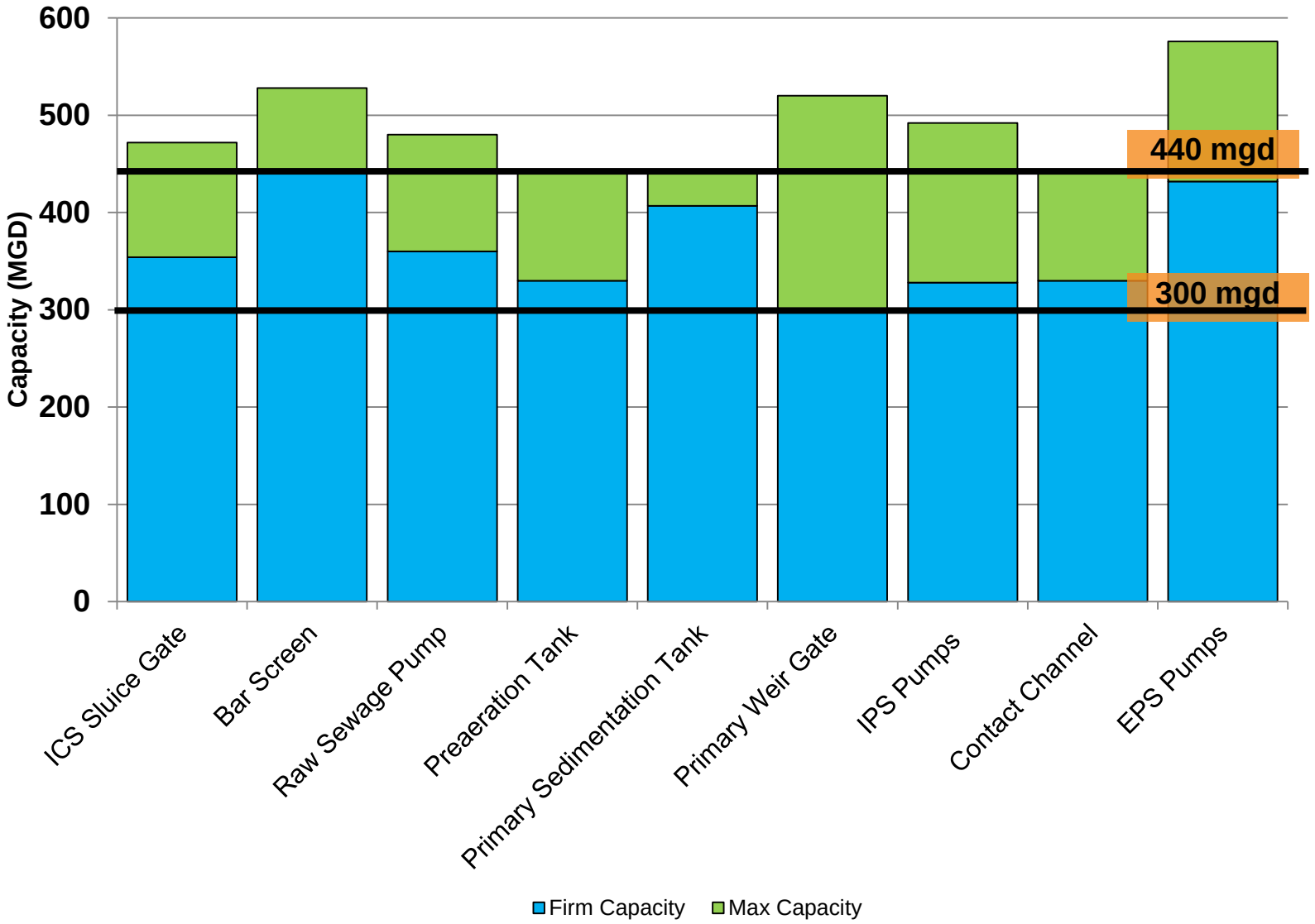
Critical Failures During Event

- Power Outage to half of Effluent Pumps
- Hydraulic Controls for all Effluent Pump Control Valves had no backup power
- High Level Float Switches in Primary Tanks did not activate
- Control System Alarms were not prioritized
- No automated indication of flooding conditions
- Manual operation required to shut off Raw Sewage Pumps

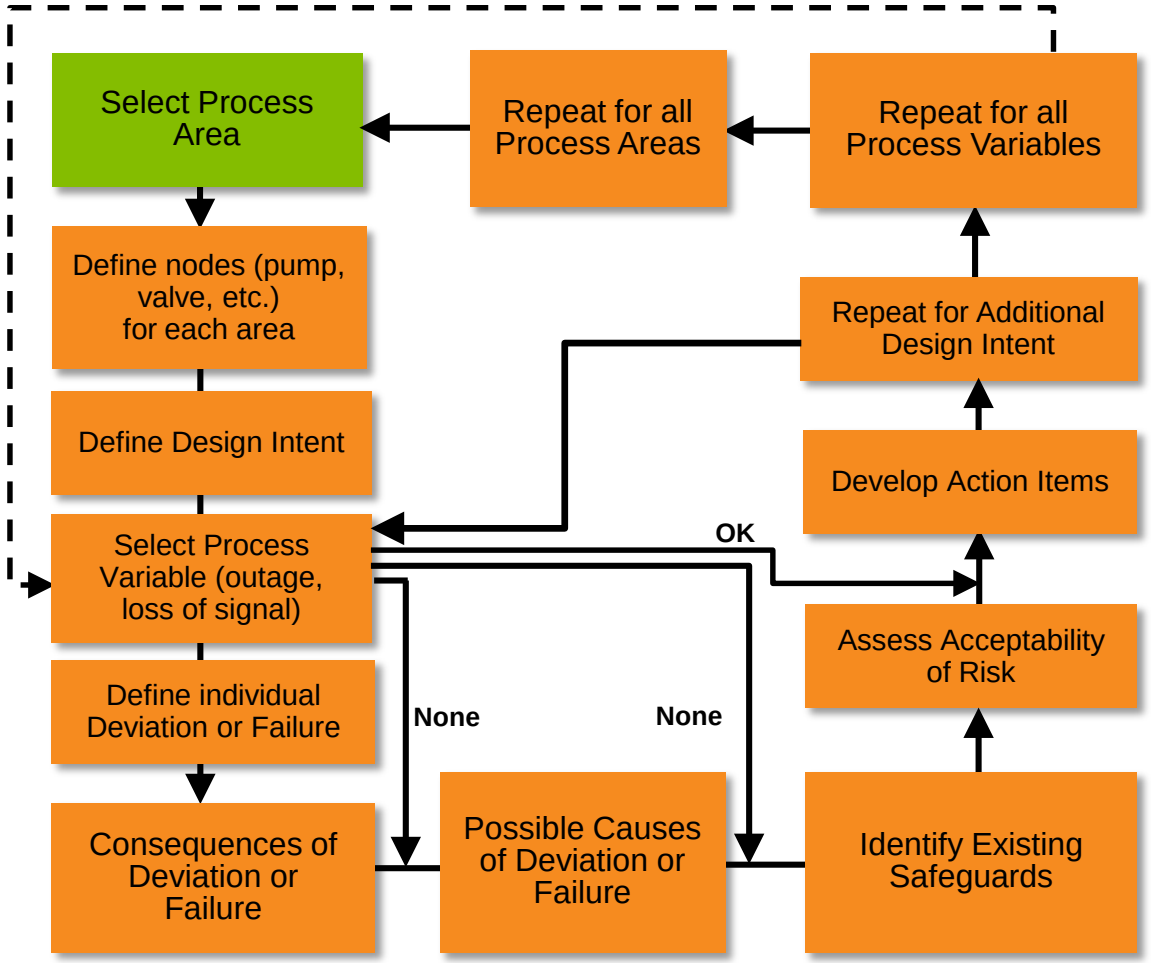
Assessment Approach

- Incident Review
- Review of Process Areas
- HAZOP Analysis
- Failure Mode Evaluation
- Mitigation Strategies
- Recommendations

Capacity Analysis



Evaluation Process - HAZOP



From BS IEC 61882

Potential Failure Mechanisms

Technical	Failure Mechanism
Plant Hydraulics	1
Influent Control Structure	7
Preliminary Treatment	2
Raw Sewage Pump Station	5
Preaeration and Sedimentation Tanks	7
Flow Diversion Structure	3
Effluent Pump Station	5
Electrical	7
Instrumentation & Control	7
Operational Areas	**Risk Factors**
Staffing	3
Operations	8
Training	5
Equipment & Systems Testing Procedures	8
Maintenance Procedures	3

Findings and Lessons Learned

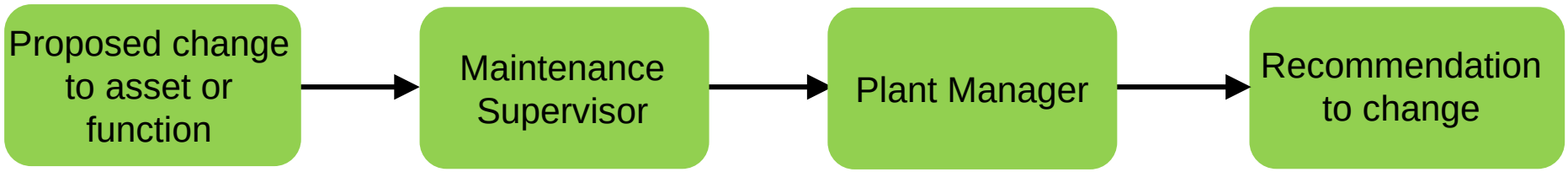
- **WPTP has many physical constraints**
- **Lack of redundancy in key process areas.**
  - Plant requires ALL systems to be fully functional to handle peak flow conditions.
- **WPTP requires a higher level of operational integration to manage interdependencies.**
- **Emergency response training did not prepare for this type of incident**
  - Operators did everything that could reasonably be expected of them
- **Current Systems are not optimized for an emergency event**
  - Control system alarms were not prioritized for emergency situations

Recommendations

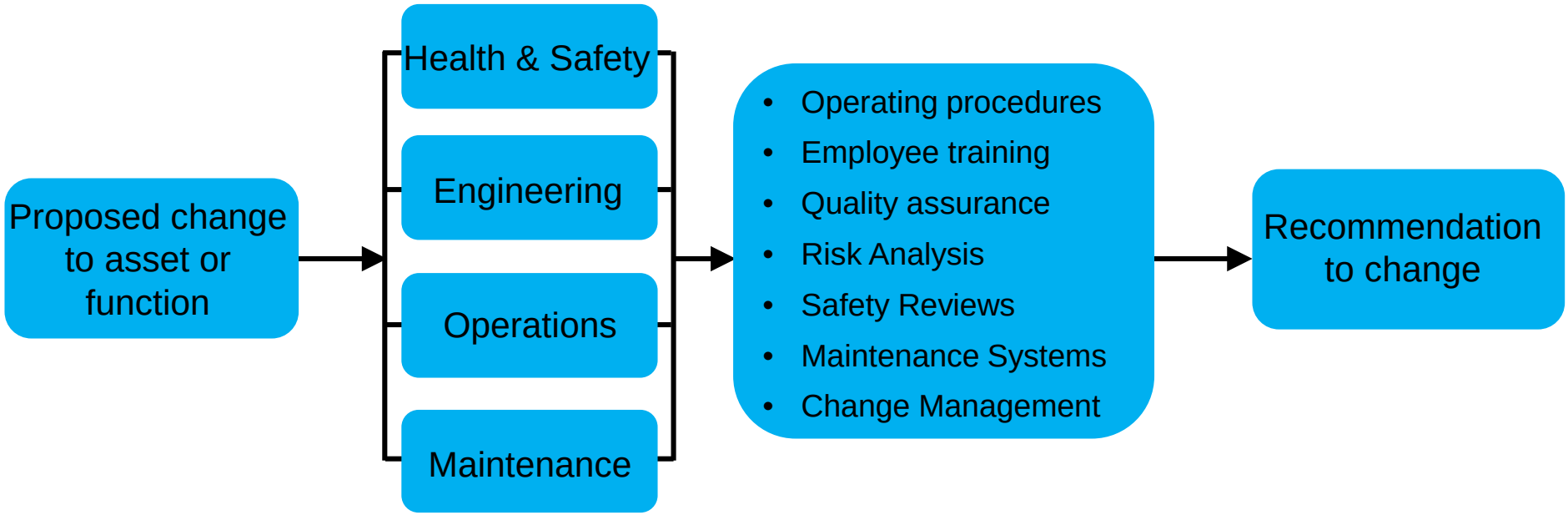
- Implement Life Safety Management System for all critical systems
- Conduct comprehensive emergency response training in different failure scenarios. Develop guidelines for bypass decision-making by operations staff.
- Conduct an integrated system-wide evaluation to address capacity constraints, redundancy and reliability. More passive systems are needed for relief from loss of automation or power outages.
- Optimize capital investment to maximize redundancy.

Life Safety Management

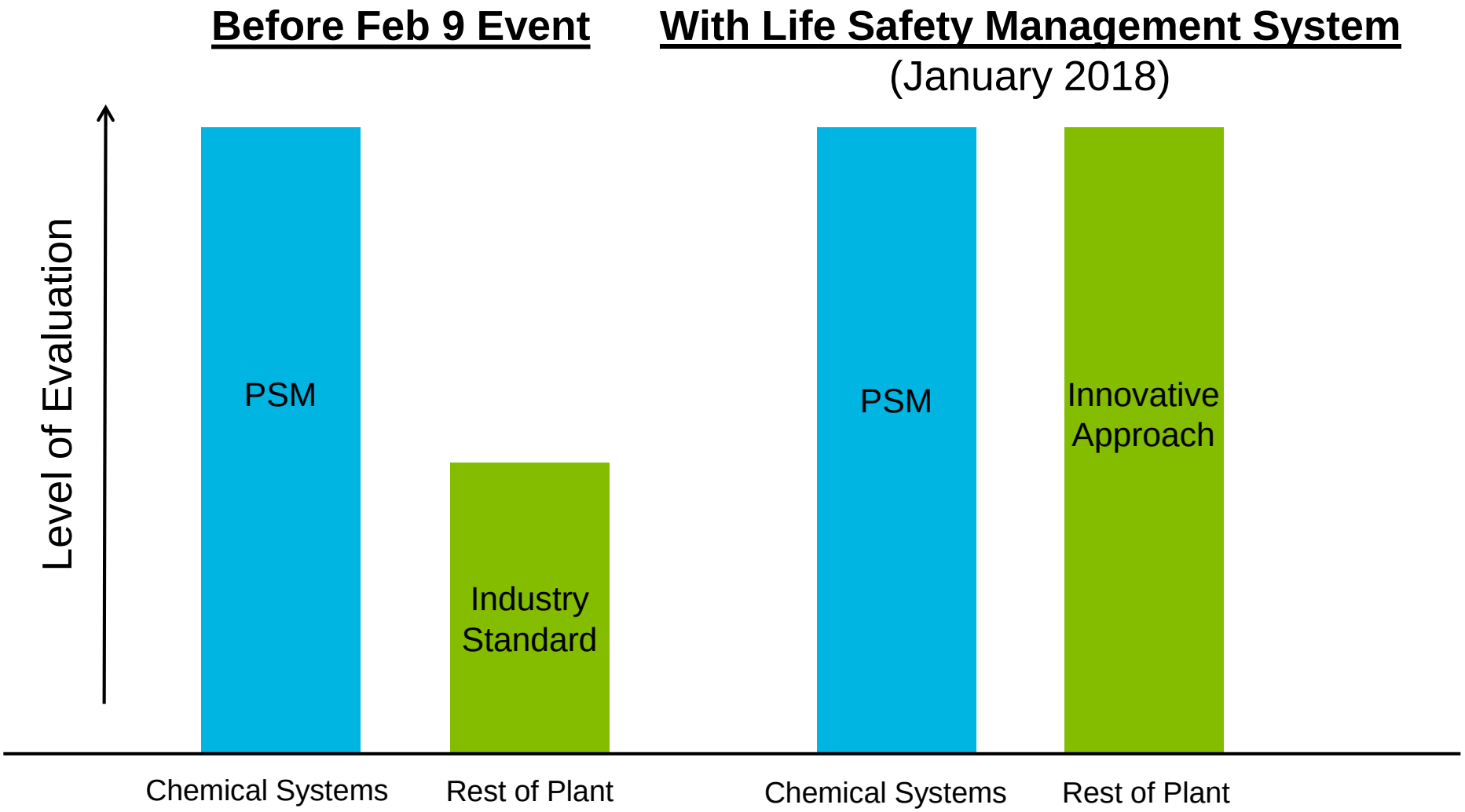
Industry Standard Practice



Life Safety Management



Operational Integration Moving Forward



PSM = Process Safety Management – Required for Chemical Systems in Plant

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Thank you