Presentation

• Background
• Incident Summary
• Investigation Approach
• HAZOP Analysis
• Failure Mechanisms
• Findings and Lessons Learned
• Life Safety Management
• Recommendations
• 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
West Point Independent Assessment

Capacity Analysis

- Firm Capacity
- Max Capacity

- ICS Sluice Gate: 300 mgd
- Bar Screen: 440 mgd
- Raw Sewage Pump: 300 mgd
- Preaeration Tank: 440 mgd
- Primary Sedimentation Tank: 300 mgd
- Primary Weir Gate: 440 mgd
- IPS Pumps: 300 mgd
- Contact Channel: 440 mgd
- EPS Pumps: 300 mgd

West Point Independent Assessment
Evaluation Process - HAZOP

1. Select Process Area
2. Define nodes (pump, valve, etc.) for each area
3. Define Design Intent
4. Select Process Variable (outage, loss of signal)
5. Define individual Deviation or Failure
6. Consequences of Deviation or Failure
7. Possible Causes of Deviation or Failure
8. Identify Existing Safeguards
9. Assess Acceptability of Risk
10. Develop Action Items
11. Repeat for Additional Design Intent
12. Repeat for all Process Variables
13. Repeat for all Process Areas
14. OK

From BS IEC 61882
## Potential Failure Mechanisms

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West Point Independent Assessment
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
• 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.
Proposed change to asset or function

- Maintenance Supervisor
- Plant Manager
- Recommendation to change

Life Safety Management

Industry Standard Practice

- Operating procedures
- Employee training
- Quality assurance
- Risk Analysis
- Safety Reviews
- Maintenance Systems
- Change Management

Proposed change to asset or function

- Health & Safety
- Engineering
- Operations
- Maintenance

Recommendation to change
Operational Integration Moving Forward

Before Feb 9 Event

- Chemical Systems: PSM
- Rest of Plant: Industry Standard

With Life Safety Management System
(January 2018)

- Chemical Systems: PSM
- Rest of Plant: Innovative Approach

**PSM** = Process Safety Management – Required for Chemical Systems in Plant
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.
Thank you