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... Creating Power for a Sustainable Future



Inherently Safer Technology
A Chemical Switching Case Study

AHMP National Conference
Presented by: Jaron Bergin
Reno, NV - August 2018

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Safer Technologies and Alternatives Analysis (STAA)
A Chemical Switching Case Study

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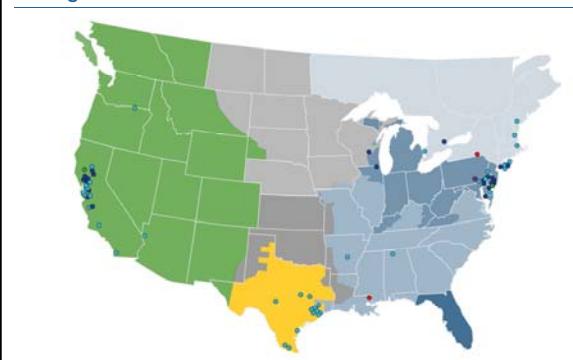
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Discussion Topics

- Background
- SCR & Ammonia
- STAA/IST Considerations & Actions

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Background




Calpine Corporation 3

Background



Calpine Corporation 4

Background



Calpine Corporation 5

Background

- PSM → CAA → RMP → Executive Order 13650
- Changes to RMP (40 CFR §68)

RMP Provisions	2017 RMP Expansion	2018 RMP Reconsideration
3 rd Party Audits	✓	
Incident Investigation RCA	✓	
STAA	✓	
Availability of Information	✓	
Public Meeting	✓	✓
Emergency Preparedness	✓	✓
OSHA Coordination		✓

- Encroaching neighbors

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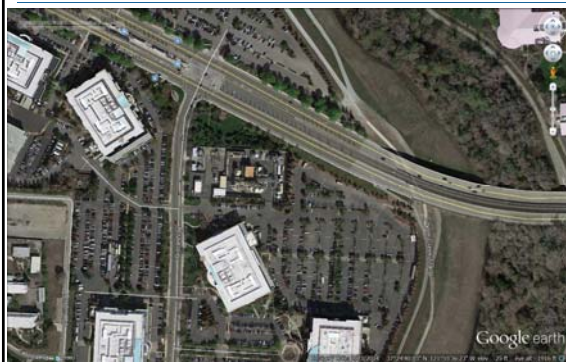
Background - Encroaching Neighbors



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Background - Encroaching Neighbors



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Background - Encroaching Neighbors



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Background - Encroaching Neighbors



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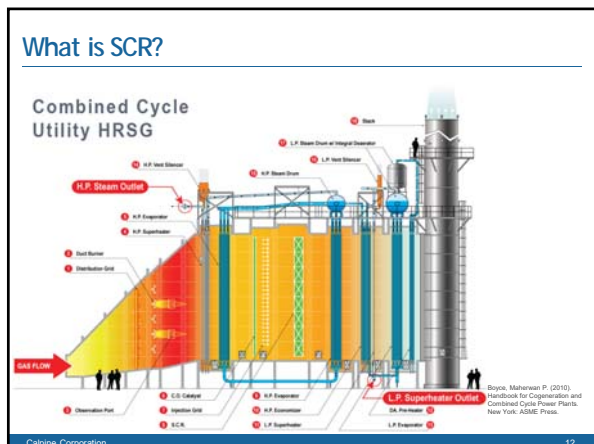
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What is SCR?

- SCR = Selective Catalytic Reduction
 - Post-combustion gas within a specified temperature range passed over catalyst
 - Ammonia grid injection upstream of catalyst
 - Ammonia and oxygen combine with NOx to form nitrogen and water
- Chemistry of the SCR Process
 - $4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$
 - $2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$

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Ammonia Risks

Physical	Compliance	Financial
Hydrophilic	PSM (OSHA)	Enforcement penalties:
IDLH - 300 ppm	RMP (EPA)	• Agency investigations
EPA DTE - 200 ppm	State Programs	• Self-reported
AIHA ERPG-2 - 150 ppm	• CalARP	Compliance Audits
Exposure Scenarios:	• Delaware ARP	PHAs and Hazard Reviews
• Loading/Unloading	• NJ TCPA	Implementation Costs:
• Equipment malfunction (tank, heater, lines, etc.)	Title V Certification	• RMP 1996 - \$1.6k - \$48k*/yr.
• Adjacent causes (fire, vehicle, etc.)		• RMP 2018 - Avg. \$3.5k**/yr.

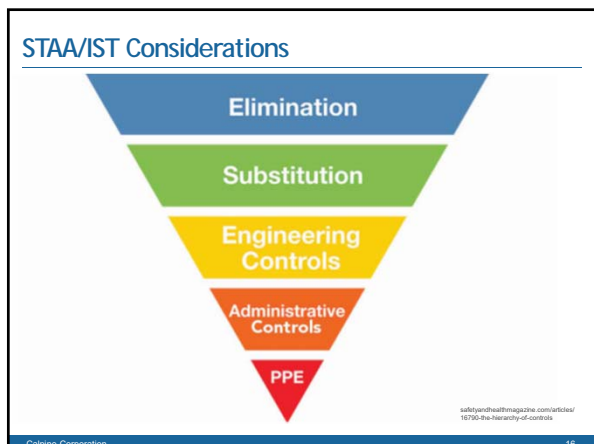
* 61 FR 31716 Adjusted to 2018 \$ / ** 02 FR 4994

- Air permit compliance
- On-site / Off-site chemical exposure

STAA/IST - Chemical Substitution

STAA - Chemical Substitution	Assumed Benefit	Estimated ±Cost
Anhydrous NH3 to <20% Aqueous NH3	↓ Compliance risk - No audits, PHAs, or EPA submittal	↓ (-\$10k/yr.)
	↓ Emergency Preparedness & Coordination	↓ (-\$3.5k/yr.)
	↓ Agency Exposure	↓ (-\$2k/yr.)
	↑ Public relations	
	↓ Physical risk - 80% lower [NH3]	↑ ~\$1-1.5MM + \$100k/yr.

- Historical Compliance - Very good
- Preventative Maintenance - No net benefit
- Exposure - Chemical deliveries
- Anhydrous to Aqueous - Good idea?



STAA/IST Actions

STAA/IST Category	Action or Policy
Engineering Controls	Engineering assessment vs. CGA G-2.1
	Technical bulletin re: NH3 monitoring and vapor mitigation
	All equipment tied to DCS with remote operation
Administrative Controls	Aqueous NH3 default for new construction
	Mechanical Integrity - Cross-reference RAGAGEP to Job Plans
	Implement internal compliance standard
	Enhanced review of Operating Procedures: <ul style="list-style-type: none"> • Emergency • Temporary • MOC

Summary

- STAA/IST switch from Anhydrous to Aqueous NH3 - Not the best option in most cases.
- EHS drivers and STAA/IST concepts better aligned with Engineering and Operations.
- Existing systems are robust and have history of safe and compliant operation.
- Employee participation - Increase awareness and involvement to maintain high performance.

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