

CSB SAFETY SPOTLIGHT: IMPLEMENTATION OF A SAFETY MANAGEMENT SYSTEM IS KEY TO A SAFER CHEMICAL INDUSTRY



U.S. Chemical Safety and
Hazard Investigation Board

U.S. Chemical Safety and Hazard Investigation Board

CSB Safety Spotlight

Table of Post-Incident Process Safety Improvements for Airgas

Topic	Current Status
Safety Management System	Committed to applying a process safety management system for the nitrous oxide business; Applying additional resources to existing facilities and rebuild of Cantonment; and Will apply the hierarchy of controls throughout including hazard reviews, management of change, and corrective actions.
Inherently Safer Design	Gathering requirements and resources to conduct design review; Developing plan to train key personnel; Receiving proposals from inherently safer design safety experts; Plan includes development of an ongoing inherently safety design component to be used in future hazard reviews; and Commitment to implement inherently safer design where feasible (practicable).
Hazard Analysis	Complete for Yazoo City and Maitland; Increasing the basis for a nitrous oxide decomposition explosion consequence to a severity-level in the criticality matrix 4; Will apply the hierarchy of controls; Developing safeguard design and availability philosophy; and Planning to transition to HAZOP and LOPA.
Apply Lessons from Previous Incidents	Developing plan to use a corporate communication process; and Will finalize after company investigation of Cantonment incident is complete.

CSB SAFETY SPOTLIGHT: IMPLEMENTATION OF A SAFETY MANAGEMENT SYSTEM IS KEY TO A SAFER CHEMICAL INDUSTRY



U.S. Chemical Safety and
Hazard Investigation Board

U.S. Chemical Safety and Hazard Investigation Board

Topic	Current Status
Apply Industry Safety Standards	<p>Completed gap analysis of CGA G-8.3-2016;</p> <p>Implementing plan to close gaps at Yazoo City and Maitland;</p> <p>Developing plan to evaluate ISA-84;</p> <p>Will incorporate ISA-84 approach in new HAZOP reviews;</p> <p>Plan developed to train key personnel on safety instrumented systems; and</p> <p>Adding industry safety standards to an existing program that monitors regulatory updates and changes.</p>
Management of Change	<p>Implemented an MOC program to nitrous oxide plants (complete).</p>
Contamination	<p>Developing engineering standard to address material of construction;</p> <p>Currently testing contamination effect on nitrous oxide decomposition;</p> <p>Testing program includes lubricants, refrigerants, metals, and metal oxides;</p> <p>Plan to incorporate testing results into process safety information; and</p> <p>Commitment to share summary of results with the Compressed Gas Association.</p>
Process Safety Information (PSI)	<p>Plan developed to apply PSM/RMP program for process safety information to nitrous oxide business.</p>
Technical Staffing	<p>Assigned an interim subject matter expert to provide additional technical support;</p> <p>Developing plans and assignments for additional technical subject matter experts;</p> <p>Obtained approval for additional technical staff resource to focus on process safety; and</p> <p>Developing an audit tool to ensure long-term commitment to sufficient technical staffing.</p>
Hourly Staffing	<p>Short term increases in current staffing levels to two operators per shift and will conduct safety review to determine long-term staffing levels and scheduling of tasks in order to improve safe operations; and</p> <p>Updating training program for operators and drivers.</p>

CSB SAFETY SPOTLIGHT: IMPLEMENTATION OF A SAFETY MANAGEMENT SYSTEM IS KEY TO A SAFER CHEMICAL INDUSTRY



U.S. Chemical Safety and
Hazard Investigation Board

U.S. Chemical Safety and Hazard Investigation Board

Topic	Current Status
Audit Program	<p>Applying Air Liquide audit program; and</p> <p>Developing a plan to review audit design.</p>
Safety Interlock Testing	<p>Developing a plan to conduct a safety review of interlock testing all interlock testing procedures; and</p> <p>Developing a plan to require a safety review of interlock testing procedures for new or modified safety interlocks.</p>
Run-Dry Safety Interlock	<p>Completed review of run-dry protection systems;</p> <p>Conducting full engineering assessment to document technical specifications and finalize engineering solution;</p> <p>Installing redundant systems with independent instrumentation on all nitrous oxide pumps; and</p> <p>Improvements at other sites for the ground pumps that at similar to pumps at Cantonment (complete).</p>
Transfer Pumps	<p>Conducting engineering review;</p> <p>Developing a plan to ensure pump systems meet NPSH guidelines;</p> <p>Maintaining additional level in some tanks as an interim safety measure;</p> <p>Developing a plan to have a standard pump and pump design;</p> <p>Evaluating additional instrumentation through hazard analysis and ISA-84 process; and</p> <p>Developing a plan for comprehensive electrical grounding and bonding systems.</p>

CSB SAFETY SPOTLIGHT: IMPLEMENTATION OF A SAFETY MANAGEMENT SYSTEM IS KEY TO A SAFER CHEMICAL INDUSTRY



U.S. Chemical Safety and
Hazard Investigation Board

U.S. Chemical Safety and Hazard Investigation Board

Topic	Current Status
Flame Arrestors	<p>Conducted literature review;</p> <p>Developed preliminary prototype designs;</p> <p>Developing plan for a comprehensive testing program;</p> <p>Planning to develop engineering standard, specifications, and written preventive maintenance plan;</p> <p>Planning to add to critical equipment list;</p> <p>Planning to develop specific audit tool for periodic evaluation; and</p> <p>Commitment to share summary of testing results and engineering specification with the Compressed Gas Association.</p>
Operations	<p>Reviewing pressure relief valve discharge locations;</p> <p>Reviewing relief valve design;</p> <p>Reviewing preventive and predictive maintenance; and</p> <p>Developing a plan for engineering modifications to reduce employee exposure to nitrous oxide.</p>
Electrical Grounding	<p>Developing a program to ensure electrical continuity for tanks and trailers.</p>