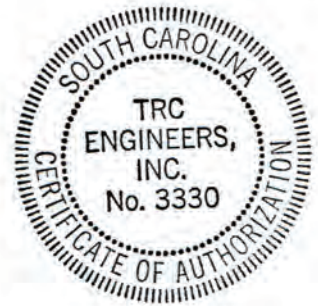




Chemical Systems Leak Prevention and Response Methods and Procedures Evaluation Report

Silfab Solar, Inc.

September 2026



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TRC Engineers, Inc. | Silfab Solar, Inc.
Leak Prevention and Response Evaluation
Final

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List of Acronyms

AED	Automated External Defibrillator
AHJ	Authority Having Jurisdiction
AODD	Air Operated Double Diaphragm
ASME	American Society of Mechanical Engineers
BAQ	Bureau of Air Quality
BPS	Bonding Procedure Specification
BPVC	Boiler and Pressure Vessel Code
BSGS	Bulk Specialty Gas Supply
CDU	Chemical Dispensing Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERT	Carolina Emergency Response Team
CGA	Compressed Gas Association
CMMS	Computerized Maintenance Management System
CO	Carbon Monoxide
CPR	Cardiopulmonary Resuscitation
CPVC	Chlorinated Polyvinyl Chloride
CVD	Chemical Vapor Deposition
DOT	United States Department of Transportation
DVB	Distribution Valve Box
EAP	Emergency Action Plan
EHS	Environmental, Health & Safety
EHSS	Environmental, Health, Safety and Sustainability
EMA	Emergency Management Agency
EMAINT	eMaintenance
EMS	Emergency Medical Service
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
ER	Emergency Response
ERT	Emergency Response Team
ESO	Emergency Shutoff
FD	Fire Department
FEAP	Facility Emergency Action Plan
FHFD	Flint Hill Fire Department
FMSD	Fort Mill School District
FRP	Fiberglass Reinforced Plastic

HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric Acid
HF	Hydrofluoric Acid
HMI	Human Machine Interface
HPM	Hazardous Production Material
H ₂ S	Hydrogen Sulfide
IBC	International Building Code
IC	Incident Commander
ICS	Incident Command System
IDLH	Immediately Dangerous to Life or Health
IFC	International Fire Code
IMS	Integrated Management System
IR	Infrared
ISO	International Organization for Standardization
KOH	Potassium Hydroxide
LEL	Lower Explosive Limit
LPCVD	Low Pressure Chemical Vapor Deposition
MAQ	Maximum Allowable Quantity
MCA	Mechanical Code Analysis
MOU	Memorandum of Understanding
NEC	National Electrical Code
NFPA	National Fire Protection Association
NH ₃	Ammonia (Anhydrous)
NTP	Normal Temperature and Pressure
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
O ₂	Oxygen
PE	Polyethylene
PECVD	Plasma Enhanced Chemical Vapor Deposition
PEL	Permissible Exposure Limit
PFA	Perfluoroalkoxy
PLC	Programmable Logic Controller
PM	Preventive Maintenance
POTW	Publicly Owned Treatment Works
PP	Polypropylene
PPM	Parts Per Million
PRD	Pressure Relief Device
PREP	National Preparedness for Response Exercise Program
PSI	Process Safety Information
PSIG	Pounds per Square Inch Gage

PSM	Process Safety Management
PES	Process Equipment System
PREP	(National) Preparedness for Response Exercise Program
PVDF	Polyvinylidene Fluoride
RFO	Restrictive Flow Orifice
RMP	Risk Management Program
SCBC	South Carolina Building Code
SCDES	South Carolina Department of Environmental Services
SCF	Standard Cubic Foot
SCFC	South Carolina Fire Code
SDS	Safety Data Sheet
SEMI	Semiconductor Equipment and Materials International
SESHA	Semiconductor Safety and Health Association
SiH ₄	Silane
SiO ₂	Silica
SOP	Standard Operating Procedure
SS	Stainless Steel
STEL	Short-Term Exposure Limit
SWPPP	Stormwater Pollution Prevention Plan
TGMS	Toxic Gas Monitoring System
VMC	Valve Manifold Box
VOC	Volatile Organic Compound
VSQG	Very Small Quantity Generator
WWTS	Wastewater Treatment System
XLPE	Cross-Linked Polyethylene

Glossary of Terms

Term	Explanation
Control area	A space within a building where hazardous material quantities are limited and managed in accordance with maximum allowable quantity provisions.
Double-wall system	A piping or containment arrangement consisting of primary containment within secondary containment to limit release of hazardous material upon failure of the inner boundary.
Excess flow control	A device or arrangement intended to limit or automatically stop flow when downstream flow exceeds a prescribed value, typically to reduce consequences of line rupture or major leakage.
Fail-safe emergency shutoff valve	A shutoff valve designed to move to its safe position upon loss of power, signal, or actuation condition, typically to isolate hazardous material flow.
Gas cabinet	A ventilated enclosure for compressed gas containers and associated components intended to contain leaks and direct releases to treatment.
Hazardous materials room	A room used for storage, dispensing, or handling of hazardous materials and subject to additional code requirements for containment, ventilation, detection, and isolation.
Health-hazard ranking	A numerical hazard rating used in NFPA 704 indicates the relative severity of health effects from exposure to a material.
Primary hazard	The principal hazard classification assigned to a material for purposes of storage, handling, and code application.
333Restrictive flow orifice	An orifice installed to limit maximum flow rate from a gas source or piping segment under normal or upset conditions.
Secondary containment	A supplemental containment system intended to capture or control hazardous material released from primary storage or piping containment.
Secondary hazard	An additional hazard classification to be considered for a hazardous material beyond its principal hazard and can affect separation, containment, and mitigation requirements.
Sensitive leak test	A leak test method with sufficiently low detection threshold to identify very small leakage rates that may not be revealed by standard hydrostatic or pneumatic pressure testing.
Service corridor	A corridor intended for building services and utility distribution rather than general occupancy, often subject to specific visibility, separation, and access provisions for hazardous material piping.
Treatment system	A system used to dilute, absorb, adsorb, neutralize, burn, contain, or otherwise process hazardous material effluent.
Ventilated enclosure	An enclosure provided with mechanical exhaust to contain and remove hazardous gases or vapors released from equipment, piping, or containers.
Hazardous materials	The term “hazardous materials” has the meaning set forth in 49 CFR 172.101.

Executive Summary

Silfab Solar, LLC (Silfab) retained TRC Engineers, Inc. (TRC) to provide a third-party professional engineering evaluation of the leak prevention and response methods and procedures for the manufacturing processes at the Silfab facility located in Fort Mill, South Carolina. The evaluation focused on the processes that use silane, anhydrous ammonia, hydrochloric acid (HCl), potassium hydroxide (KOH), and hydrofluoric acid (HF), and included a third-party review of the facility's emergency response procedures. TRC's evaluation and review was performed from April 2026 through August 2026 and was based upon documents provided by Silfab and information obtained during on-site visits involving personnel interviews, records reviews, and field observations. Silfab provided additional and updated documentation to be considered by TRC throughout the evaluation and review process. This report represents the results of the TRC's evaluation and review.

TRC assessed over a dozen sections in the South Carolina Fire Code and South Carolina Building Code for semiconductor manufacturing activities and associated hazards, as well as eleven different industry packages referenced by code as part of the evaluation. Over 2,000 pages of code and related material were reviewed by TRC. In addition to codes, federal regulations such as 29 CFR 1910.119 and 40 CFR 68 were consulted in the context of leak prevention and response. TRC also reviewed hundreds of design files and over 250 operating and maintenance procedures and emergency response procedures.

TRC identified several design features associated with the facility's manufacturing process that should enhance Silfab's ability to identify, manage, and respond to leaks:

Double-wall Piping for the Liquid Chemicals of Interest: From the offloading of liquid chemicals (i.e., HF, HCl, & KOH) through the delivery of liquid chemicals to the process, the pipe system used for transfer was observed to be primarily of a double-wall design. A large majority of the secondary piping was either transparent or translucent, allowing a leak in the primary piping to be visually detected. Secondary piping was designed to drain via gravity to locations equipped with leak detection sensors intended to provide alarms in the event of a leak from the primary piping.

Double-wall Metal Tubing or Piping for the Gas Chemicals of Interest: Similar to the liquid systems, the metal tubing or piping for silane and anhydrous ammonia was primarily of a double-wall design. The interstitial space was designed to be monitored via a vacuum decay method intended to alarm should a leak in the primary tubing or piping be detected.

Storage Containment for Liquid Chemicals of Interest: The storage tanks for the liquid Chemicals of Interest were located inside a building detached from the main production area. HF and HCl storage tanks were located in one room of the building, and the KOH tank was located in an adjacent room of the building, each with separate secondary containment. Containment calculations reviewed by TRC indicated these rooms were designed such that a release of the entire contents of a tank would be contained within each room with additional freeboard for water from fire suppression systems. The

buildings were equipped with sumps and pumps that would allow spilled material to be pumped to the on-site wastewater treatment plant or other location, if needed.

Vapor Monitors in Strategic Locations: Silfab had installed Toxic Gas Monitoring Systems (TGMS) that consisted of a network of RKI GD-70D monitors with sensors for monitoring oxygen, HF, HCl, silane, and ammonia. The monitoring sensors were located throughout the process including the gas offloading area, the liquid storage rooms, and other areas of operation. These systems were designed to alarm the facility of potential leaks or releases of material throughout the process. At the time of the evaluation, Silfab had installed approximately 26 gas monitors throughout the process.

TRC's approach to evaluating Silfab's leak prevention and response methods and procedures included seven focus areas. These focus areas and a brief overview of recommendations are outlined below.

■ *Environmental Health and Safety (EHS) Management System*

Silfab documented management commitment at the highest level with corporate Environmental Health and Safety (EHS) policies, demonstrated EHS employee training through a Learning Management System, committed to ISO 45001 and 14001 certifications and instituted an Environmental Health Safety and Sustainability governance body reporting directly to the Board of Directors. Recommendations related to this focus area are described in Section 3.7 of this report and include, but are not limited to, proceeding with implementation of management systems and ISO 14001 & 45001 certifications.

■ *Design codes and standards associated with the process*

At the time of this evaluation, the 2021 South Carolina Building Code (SCBC) and the 2021 South Carolina Fire Code (SCFC) established the basic framework for occupancy classification, hazardous material control areas, and the special requirements applicable to high-hazard and hazardous production material uses. These two primary codes reference companion codes and consensus standards that become enforceable to the extent referenced, including specific sections of National Fire Protection Association (NFPA), American Society of Mechanical Engineers (ASME) and Compressed Gas Association (CGA) codes and/or standards.

TRC made recommendations in this focus area which are described in Section 4.6 of this report and include, but are not limited to, updating engineering drawings to show implemented safeguards or inherently safe design and installing additional gas monitoring in exhaust ducting from enclosures to supplement the existing area gas monitors. TRC also identified several best practice considerations in this focus area.

■ *Construction documentation associated with the process*

Based on the information provided by Silfab throughout the evaluation process, it appeared the facility had the proper construction documentation according to ASME B31.3 requirements for records of materials, certifications, inspection, examination, and personnel qualifications for piping systems associated with the manufacturing process.

■ *Operating procedures for the process associated with managing leaks*

The facility's methods and procedures appeared generally consistent with industry practices for managing a process shutdown and cleanup in the event of a leak. The chemical storage and production equipment had spill containment integral to the design with automated alarm and/or response from integrated controls along with associated SOPs providing procedural responses to various anticipated situations. Process air emissions were to be treated in existing air pollution control equipment prior to exhaust. The SOPs, personnel training and emissions control devices appeared appropriate for protection of facility personnel. TRC identified best practices considerations for this focus area that are presented in Section 6.2 of the report. Implementation of these recommendations should strengthen Silfab's existing leak prevention and response capabilities.

Silfab had not yet commissioned the operating equipment for its manufacturing process at the time of TRC's evaluation. Recommendations and best practices considerations for Silfab to consider for future commissioning activities have also been provided in Section 6.2. These additional recommendations should be addressed during check-out, start-up and commissioning of the process. The additional recommendations include, but are not limited to, finalizing installation and verifying functionality of planned leak detection, alarms, interlocks, and flow directions throughout the process; continued development and implementation of operating procedures; and completing operator training as part of pre-commissioning activities.

■ *Maintenance procedures associated with managing leaks*

Silfab had compiled a detailed maintenance and work order management system for the facility, the process areas, and the process equipment. This system included scheduled preventive maintenance work orders to preserve the integrity of process equipment and thus prevent leaks. TRC identified several best practices considerations associated with the maintenance program that are presented in Section 7.4.

■ *Response procedures associated with managing leaks*

Silfab had developed a detailed Emergency Action Plan. The onsite leak response program included First Responder Awareness trained employees. The Emergency Response Team (ERT) members were trained to First Responder Operations Level (i.e., contain a release) with a subset of the ERT trained to the HAZMAT Technician level (i.e., initiate actions to stop releases and begin clean-up activities). TRC identified recommendations and best practices for Silfab to consider in Section 8.3 of the report related to the employee intercom system installation, exit signage between two buildings, and access control to PSM areas.

■ *Emergency response procedures and coordination with coordinating outside responders (i.e., public agencies, contractors, etc.) and the community.*

Silfab had planned with local response agencies, using the Incident Command System (ICS) framework for a coordinated effort in the event of an emergency situation. Local response

agencies had visited the Silfab site, appeared to understand the hazards and were committed to maintaining open communication and drills regarding potential release scenarios with Silfab to test the combined on-site emergency response capabilities and readiness. TRC identified recommendations and best practices considerations/observations in this focus area including updating the facility's release reporting procedure.

At the time of TRC's evaluation, Silfab had paused commissioning activities involving the handling or use of Chemicals of Interest and therefore had not yet fully implemented monitoring systems, alarms, and programs associated with leak detection and prevention at the manufacturing process. As a result, TRC was unable to observe equipment, review functionality of systems and alarms, or observe implementation and effectiveness of maintenance programs while the process was in operation. TRC's evaluation was based on the conditions observed and documentation reviewed at the time of the assessment. Evaluation of Silfab's leak prevention and response methods should continue throughout the commissioning process.

In general, this evaluation and review finds that Silfab had undertaken, and was in the process of implementing, measures to prevent and respond to potential releases from the facility's manufacturing process that were consistent with industry standards for handling the chemicals of interest. Through the commissioning process, Silfab should implement recommendations in this report and continue evaluation of the facility's leak prevention and response methods. In addition, Silfab should provide the South Carolina Department of Environmental Services (SCDES) with confirmation that recommendations associated with the leak prevention and response methods have been completed.

Section 1

Background

1.1 Silfab Facility

Silfab owns and operates a Facility for assembly and production of solar panels and cells located at 7149 Logistics Lane, Fort Mill, York County, South Carolina 29715. The production of solar cells from components (“manufacturing process”) requires use of chemicals listed as Regulated Substances potentially subject to regulation under 40 CFR Part 68. The South Carolina Department of Environmental Services (SCDES) issued Synthetic Minor Construction Permit No. 50000090 v1.0 to Silfab on March 1, 2024 (“Permit”), authorizing construction of identified air emission sources, including installation of emissions scrubber technology to treat regulated compounds emitted from facility processes. DES also issued a permit for the installation of a wastewater pretreatment system on May 24, 2024, which requires pre-treatment and removal of wastewater pollutants prior to being discharged to the local Publicly Owned Treatment Works (POTW). Solar panel assembly operations at the facility started on or about October 2025 after receiving a Temporary Certificate of Occupancy from York County. The assembly operations do not require the use of chemicals regulated under the RMP regulations. Silfab received a full Certificate of Occupancy on February 13, 2026, from York County and was in the process of commissioning of solar cell manufacturing operations at the facility prior to pausing commissioning activities.

The production of solar cells requires the use of specific chemical substances that are regulated by 40 CFR Part 68 when present on site above certain threshold quantities. The Regulated Substances required for solar cell production at the Silfab facility, potentially present above the risk management program thresholds, include silane (SiH_4), anhydrous ammonia (NH_3), and hydrochloric acid (HCl). At the time of TRC’s evaluation; silane and anhydrous ammonia trailers were stored on-site; however the trailers were not connected to the process, and the connection hoses were locked out. There was no HCl observed at the site.

TRC was retained by Silfab to provide a third-party professional engineering evaluation of the facility’s leak prevention and response methods and procedures for the use of Silane, Anhydrous Ammonia, Hydrochloric Acid (37%), Potassium Hydroxide (45%) and Hydrofluoric Acid (49%) in the manufacturing process, as well as a review of the Facility’s emergency response procedures. These five chemicals are identified as “Chemicals of Interest” in this report.

1.2 Regulations, Codes, & Industry Standards

As part of the evaluation and review TRC assessed the Silfab processes against regulations, codes and standards.

1.2.1 Regulations

Regulations are legally enforceable requirements established by governmental authorities. Regulations typically define minimum requirements that organizations must satisfy to protect public health, safety, environmental quality, and worker welfare. Examples include Occupational Safety and Health Administration (OSHA) regulations, Environmental Protection Agency (EPA) regulations, and state or local fire and building regulations. Compliance with applicable regulations is mandatory.

1.2.2 Codes

Codes establish minimum requirements for the design, construction, installation, operation, and maintenance of facilities and equipment. Building, fire, mechanical, electrical, plumbing, and fuel gas codes are common examples.

Codes may be developed directly by code-writing organizations, such as the International Code Council (ICC) or the National Fire Protection Association (NFPA), and subsequently adopted into law by a state, county, municipality, or other regulatory authority. Codes are enforceable requirements adopted by a jurisdiction or authority having jurisdiction (AHJ). Compliance with applicable adopted codes is therefore mandatory.

1.2.3 Standards

Standards are technical documents developed by recognized organizations such as the American Society of Mechanical Engineers (ASME), National Fire Protection Association (NFPA), and Compressed Gas Association (CGA). Standards typically provide detailed technical requirements, engineering methods, material specifications, testing procedures, and design criteria.

Unlike regulations or adopted codes, standards are generally not legally enforceable on their own. Instead, they become enforceable when adopted by code or the AHJ. For example, a building or fire code may require a flammable storage system to comply with specific provisions of NFPA. Once referenced by the adopted code, the applicable portions of NFPA effectively become part of the code requirements and carry the same enforceable status as the code itself.

1.2.4 Industry Best Practices

Industry best practices represent commonly accepted engineering, operational, and safety approaches that have evolved through industry experience, lessons learned, research, and professional judgment. Best practices may be derived from industry guidance documents, technical publications, trade association recommendations, or historical operating experience.

Unlike regulations, codes, or incorporated standards, industry best practices are generally voluntary unless specifically required by a code, regulation, contract, or company policy.

However, best practices are often used to supplement minimum code requirements and to improve safety, reliability, operability, and maintainability.

1.2.5 Relationship Between Regulations, Codes, Standards, and Industry best Practices

The relationship among regulations, codes, standards, and industry best practices can generally be viewed as a hierarchy:

1. Regulations establish legal requirements and have the highest authority.
2. Adopted Codes provide enforceable technical requirements used to satisfy regulatory objectives.
3. Referenced Standards provide detailed technical criteria and become enforceable when incorporated by regulations or adopted by the AHJ.
4. Industry Best Practices supplement the foregoing requirements and are generally voluntary unless otherwise mandated.

1.3 Recommendations vs. Best Practices

For the purposes of this report, recommendations are actions identified to address code compliance gaps or areas requiring additional documentation, safeguards, or design modifications. Best practices, by contrast, are measures that exceed minimum compliance requirements and are based on recognized industry experience, consensus guidance, lessons learned, or sound engineering judgment. While recommendations are generally necessary to support compliance, best practices are intended to enhance safety, reliability, operability, and maintainability beyond the minimum requirements established by code.

Section 2

Approach

TRC's approach to evaluating the Silfab facility's leak prevention and response methods and procedures focused on the review of processes where a potential leak of Chemicals of Interest may occur including a review of the overall management program, system design and construction documentation, operating and maintenance procedures, and internal emergency/incident response procedures. The evaluation consisted of a review of the manufacturing process, storage, transfer and use of Chemicals of Interest, documentation provided by Silfab, interviews with Silfab personnel and community response personnel, and on-site field reviews of the installed equipment and operations at the Facility. The wastewater system and the emission control systems were included in the evaluation as they related to the potential for a leak or release.

TRC's review of the facility's emergency response procedures focused on processes where a release of Chemicals of Interest requiring emergency response may occur and the associated internal, contract, and external emergency/incident response procedures. TRC's review was based upon documents provided by Silfab, interviews with responding agencies and response contractors, as well as on-site visits involving personnel interviews, records reviews, and field.

Silfab periodically provided additional and updated documentation to be considered by TRC throughout the evaluation. This report represents the results from TRC's evaluation and review as of the date of the report issuance.

2.1 Management Program

TRC evaluated the management programs established and implemented to support the prevention, and response to potential leaks of Chemicals of Interest throughout the manufacturing process. This evaluation included a review of the quality and implementation of the management programs used at Silfab to manage the risks associated with the storage and use of Chemicals of Interest.

Recommendations regarding the management program are included in Section 3.7.

2.2 Leak Prevention Methods and Procedures

TRC evaluated the following information related to leak prevention for Chemicals of Interest:

- System design records for the manufacturing process equipment and control systems associated with the Chemicals of Interest, including codes and standards used in the design of the process systems.

- System construction documentation for the manufacturing process equipment and control systems associated with the Chemicals of Interest, including “as-built” construction, testing, and inspection documentation prior to the commissioning of the related process equipment and control systems.
- System operation documentation for the manufacturing process equipment and control systems associated with the Chemicals of Interest, including operating procedures for the applicable systems that address the inspection of potential leaks upon startup of the process (e.g., checks performed while the system is running, operating parameters that must be followed to prevent over pressurizing the system, etc.), the actions that must be taken and the response time to address any leaks discovered during operation, as well as operator training documentation related to leak prevention and response methods and procedures.
- System maintenance documentation for the process equipment and control systems associated with the Chemicals of Interest, including the scheduled maintenance and preventive maintenance (PM) programs that have been implemented to inspect and maintain the ongoing integrity of the systems to prevent leaks and implement timely repairs when leaks occur.

As a result of this evaluation, TRC developed written recommendations to improve upon the existing leak prevention methods and procedures for each applicable system and the related Chemical of Interest (Sections 4.6, 5.3, 6.2, and 7.4). The leak prevention analysis for design and construction documentation was limited to distribution systems for silane, anhydrous ammonia, hydrochloric acid, hydrofluoric acid, and potassium hydroxide and did not include wastewater treatment or other production chemicals. The evaluation of operation and maintenance procedures included the detection of potential leaks from the wastewater treatment and pollution abatement systems.

2.3 Leak Response Methods and Procedures

TRC’s evaluation of leak response methods and procedures focused on the facility’s on-site emergency response team procedures, response training, and response equipment for the manufacturing process. The evaluation included a review of the following information:

- Methods and procedures developed and implemented to monitor, inspect, and detect leaks within the applicable systems.
- The facility’s notification procedures (if leaks are detected) and the associated on-site response capabilities, equipment, protocols and procedures for each Chemical of Interest.

As a result of this evaluation, TRC developed and provided written recommendations (Section 8.3) to improve upon the existing leak response methods and procedures for each applicable system and the related Chemical of Interest.

2.4 Emergency Response Procedures

TRC performed the following tasks related to emergency response procedures:

- Conducted a review of Silfab’s emergency response procedures
- Performed a comprehensive assessment of the Facility’s emergency response training program, including role-based requirements and compliance with applicable standards
- Evaluated coordination with local emergency responders and services, including verification of contact information, communication protocols, and integration with external agencies including:
 - York County Emergency Management Agency (EMA)
 - Flint Hill Fire Department (FHFD)
 - Hospital or nearest facility that would receive exposed / injured personnel
 - Silfab’s Contract Response Teams (e.g., HEPACO, CERT, HazMat NC)
 - SC DES RMP Coordinator
 - Fort Mill School District (FMSD) representatives
 - Suppliers of the “chemicals of interest”
- Reviewed existing drills and exercises programs, including types, frequency, and alignment with applicable guidance (e.g., National Preparedness for Response Exercise Program (PREP) or other regulatory standards)
- Assessed notification procedures, including internal and external notification criteria, communication methods, escalation protocols, and regulatory reporting requirements

This report documents TRC’s findings and observations, identifying potential gaps related to required emergency response protocols.

As a result of this evaluation, TRC developed written recommendations (Section 9.7) to the emergency response procedures related to the Chemicals of Interest.

2.5 Limitations and Clarifications

- TRC’s evaluation and review was performed during the April 2026 to August 2026 time period and was based upon documents provided by Silfab, as well as information obtained during on-site visits.
- TRC did not “field verify” equipment construction, equipment integrity, process interlock functionality, or process controls programming for the systems associated with the Chemicals of Interest. TRC reviewed information provided by Silfab associated with design, construction, and operation of the applicable systems to evaluate the leak prevention and leak response methods and procedures in place at the facility.
- The codes and standards evaluation was based on design documents and construction documents provided by Silfab. Field verification was limited to separation distances, signage, the presence of pressure relief devices, and the location of emergency stops. The code review was limited to

process and mechanical aspects related to leak prevention and response methods and procedures for the Chemicals of Interest and excluded other engineering disciplines (e.g., electrical, civil, structural, etc.).

- A review of bulk chemical/gas delivery containers (i.e., trailers, isotainers, etc.) not owned by Silfab was excluded from TRC's Evaluation. It was assumed that the container and/or the transportation vendor who provided these pieces of equipment are responsible for the proper design and maintenance of these containers.
- Code review for equipment used in the manufacturing process (e.g., pumps, heat exchangers, fabrication equipment/tools, etc.) was not included in this evaluation.
- This evaluation for leak detection and response methods and procedures and review of emergency response procedures was not an audit of the facility's obligations under 29 CFR 1910.119 (Process Safety Management) or 40 CFR 68 (Chemical Accident Prevention Provisions). Program documents related to these standards were used to complete the evaluation and review; however, this report was not intended in scope to satisfy the regulatory audit requirement for these federal OSHA/EPA rules.
- TRC's evaluation and review does not provide any certifications or guarantees regarding leak prevention and response or emergency response at the Silfab facility. This report presents TRC's observations, findings, conclusions, and recommendations as they existed at the time the report was issued. TRC makes no representation or warranty that the current or future operations are or have been in compliance with applicable federal, state, and local laws, regulations, and codes. TRC makes no guarantees as to the accuracy or completeness of information obtained or reported from others during the course of this evaluation and review. The findings presented in this report are based upon reasonably ascertainable information and observed conditions at the time of the evaluation and review.

Section 3

Leak Prevention and Response - Management System

TRC evaluated the management systems established to support the prevention, and response to potential leaks throughout the manufacturing process. This evaluation included a review of the quality and implementation of programs utilized by Silfab to manage the risks associated with the use of Chemicals of Interest.

Silfab provided TRC with information related to the following management systems as part of this evaluation:

- Revised Environmental Policy (January 2026)
- Revised Health and Safety Policy (November 2025)
- Establishment of an Environmental, Health, Safety and Sustainability Committee reporting directly to the Silfab Board of Directors (March 30, 2026)
- Establishment of a schedule for ISO Certification by the end of 2026 for ISO 14001 (Environmental Management System) and ISO 45001 (Occupational Health and Safety Management System)
- Deployment of an electronic EHS Compliance Management System, provided by Velocity EHS
- Deployment of a Learning Management System (LMS)

3.1 Environmental Policy

Silfab developed an Environmental Policy (Appendix A) which describes its environmental commitment and was signed by the President and CEO as well as the Chief Operating Officer. It was most recently revised in January 2026. As it pertains to leak prevention and response, it identified the company's commitment to:

- Continually improve its environmental programs.
- Maintain a formal Environmental Management System.
- Comply, and where possible go beyond, applicable federal, state, and local environmental laws and regulations, and other requirements to which Silfab subscribes.
- Provide employee training and awareness of the environmental impacts of their work activities, as well as how to minimize those impacts.
- Continuously improve by reviewing the Environmental Management System through internal audits and related objectives and targets, policy and practices.

Silfab developed several environmental programs and mandated training for applicable employees on those programs. These programs are identified and the training tracked in the Learning Management System described in Section 3.6.

The environmental policy is identified as an ISO 14001 document as part of Silfab's ongoing ISO certification efforts. The Silfab Fort Mill facility will rely on the ISO 14001 implementation and certification to document its formal Environmental Management System. The status of this implementation is addressed in Section 3.4.

3.2 Health and Safety Policy

Silfab developed a Health and Safety Policy (Appendix B) which describes its commitment to keeping employees safe and was signed by the President and CEO, the Chief Operating Officer, and the Chief People Officer. It was most recently revised in November 2025. As it pertains to leak prevention and response it identifies the company's commitment to:

- Remain in compliance with all applicable statutory requirements concerning Health and Safety.
- Develop and implement the Health and Safety programs and ensure continual improvement of their results and overall performance.
- Create a physically and psychologically safe work environment.

The policy represents that these commitments will be achieved through:

- Regular review of requirements and making adjustments to programs.
- Setting clear expectations regarding Health and Safety related roles and responsibilities for all stakeholders, including contractors and subcontractors.
- Encouraging the involvement of all employees and engaging with them to create a safe work environment.

Silfab developed several safety programs and mandated training on those programs. These programs are identified and the training tracked in the Learning Management System described in Section 3.6.

The Silfab Fort Mill facility was in the process of implementing and obtaining certification of an ISO 45001 Occupational Health and Safety Management System. The status of this implementation is addressed in Section 3.4.

3.3 Environmental, Health, Safety and Sustainability Committee

On March 30, 2026, the Silfab Board of Directors established an Environmental, Health, Safety & Sustainability (EHSS) Committee ("Committee"). This Committee is a governance and oversight body for operations, reporting to the Board of Directors.

The EHSS Committee provides independent oversight of operational performance related to employee responsibilities and expectations under the Environmental Policy and Health and Safety Policy. The Committee monitors risk, compliance, and performance; provides direction and recommendations to operations leadership; and escalates material EHSS matters to the Board of Directors. They are charged with the oversight for the prevention of work-related injury, illness, and environmental harm, ensuring effective identification and control of EHSS risks within operations, monitoring compliance with applicable safety and environmental regulations, promoting a culture of accountability, worker participation, and continual improvement, and supporting sustainable and responsible operational practices aligned with company strategy.

The EHSS Committee consists of members from the Board of Directors and cross-functional senior leaders and subject-matter experts representing Operations, Human Resources, Safety, Facilities, Environmental Management, Sustainability, and Risk. These members are appointed by executive leadership or the Board. A Chair is designated to lead meetings and report to the Board of Directors.

The EHSS Committee is scheduled to meet and report to the board on a quarterly basis. The initial EHSS Committee meeting was held in March 2026. At the May 2026 meeting, Silfab indicated the committee set its short-term focus on the safe chemical operations at the Fort Mill facility.

As a Board of Directors committee for oversight and governance, the information reviewed by this Committee has been deemed confidential.

Additionally, Silfab has implemented a Sustainability and Safety Committee. This team meets monthly and is chaired by the Director of Sustainability. This team focuses on corporate EHS Key Performance Indicators (KPIs), Departmental KPIs, Sustainability Strategies and Priorities, and public reporting obligations.

3.4 ISO Certifications

Silfab indicated they are pursuing an ISO Integrated Management System (IMS) Certification for ISO 9001 (Quality), 14001 (Environmental) and 45001 (Occupational Health and Safety). They were in the process of developing a companywide system for certification across their three facilities, had selected a consultant to support the process, and planned to use Bureau Veritas (BV) for their ISO Registrar.

An ISO IMS should assist Silfab with maintaining a management focus on the EHS priorities including implementation of leak prevention measures. The context of the organization will identify the internal and external issues affecting EHS, and the interested parties' needs and expectations (including customers, regulators, employees and the community). The Leadership and Policy Elements should define roles, responsibilities, and employee participation in the EHS system. The Planning and Operation Elements should identify the environmental aspects and impacts, and the health and safety hazards and risks and how they are effectively controlled. Finally, through evaluation and continual

improvement, the system must continually be modified to better serve the EHS needs for the organization.

Silfab represented that an internal ISO implementation team meets weekly with Silfab's consultant to advance the development of the EHS system. Silfab had developed a roadmap that identifies key milestones in the IMS implementation process (Appendix C). Silfab indicated the annual Management System Review was completed in April 2026. The on-site gap assessments for the Silfab sites were in the process of being completed for all three ISO Programs at the different facilities. In June 2026, the site had its on-site internal audit for ISO 9001. The Fort Mill gap assessment site visit for EHS compliance was reportedly scheduled for August 2026. Silfab indicated their target date for full IMS certification of the EHS system was sometime in November 2026.

3.5 Velocity EHS

Silfab selected Velocity EHS as enterprise-wide integrated EHS Management tool to help facilitate completion and documentation of EHS obligations including those applicable to prevention and response to a potential release of Chemicals of Interest.

These types of web-based systems can be useful to assist organizations with managing compliance risks and have the potential to support many aspects of EHS obligations when fully implemented. The Fort Mill facility recently initiated the use of this tool in June 2026. Configuration of the software system involves careful population of requirements into the system in a manner that is consistent with the organization's specific obligations, work practices, and culture. Silfab indicated that they would focus the initial implementation on the Incident Management and Enhanced SDS Management elements in the software and the use of this system will move to other EHS program elements over time.

3.6 Learning Management System

Silfab indicated they use a Learning Management System (LMS) to manage EHS Training programs. The LMS is a computer-based training system that covers approximately 24 general EHS topics that are important for employees to understand. The training includes a test at the end of each module, and a passing grade of 80 percent is required for each module before the employee can move to the next module. The system is intended to generate management reports that will provide updates on the status of training for each employee. Silfab indicated the LMS modules are required for new employees and must be renewed annually, staggered throughout the year.

Per Silfab, there are several learning modules that are site specific and delivered in person to each employee including an Environmental Overview, a Safety Overview, and manufacturing overviews that include descriptions of the chemicals used on-site. The training program is described in the New Employee Orientation procedure (Appendix D).

3.7 Recommendations

Silfab has made commitments to establishing, implementing, maintaining and improving their integrated EHS management system. When applied properly by senior leadership, the EHS Management System can provide a robust platform to help Silfab manage their EHS priorities, including leak prevention and response methods and procedures for the use and management of the Chemicals of Interest.

To ensure an appropriate EHS Management System is established, implemented, maintained and continually improved upon, TRC recommends the following actions for the facility:

- Continue with the ISO Certification Process.
- Continue to expand the use of Velocity EHS to capture the applicable EHS requirements and actions that must be completed to maintain compliance, as well as environmental obligations and risks.
- Periodically, at least annually, review and update the corporate Environmental Policy to ensure it reflects the corporation's commitments to prevent and respond to leaks of Chemicals of Interest
- Update the New Employee Orientation modules to include all the chemicals used in the manufacturing process, including the Chemicals of Interest.
- Assess the resource levels required to robustly develop and maintain these management systems, and the other systems identified throughout this evaluation, and provide the resources necessary for these systems to be sustainably successful.

Section 4

Leak Prevention and Response - Design Documentation

4.1 Applicable Codes and Standards

TRC conducted a review of the applicable codes and standards for the operations at the Silfab site based on the available design documentation provided by site representatives. At the time of this evaluation, the 2021 South Carolina Building Code (SCBC) and the 2021 South Carolina Fire Code (SCFC) established the basic framework for occupancy classification, hazardous material control areas, and the special requirements applicable to high-hazard and hazardous production material uses. The building code governs the overall building configuration and design basis, while the fire code governs operational and protection features associated with hazardous materials storage, use, handling, emergency controls, detection, exhaust, and related fire and life safety measures.

The primary codes do not stand alone; they incorporate and rely on numerous companion codes and consensus standards that become enforceable to the extent referenced. For example, fire code incorporates extensive referenced standards and commonly invokes the National Fire Protection Association (NFPA) codes and standards, as well as equipment and material standards, applicable to hazardous materials installations. Accordingly, the practical design hierarchy is the adopted building and fire codes which define what systems and protections are required, while the referenced standards and companion codes define how those systems are to be engineered, constructed, tested, and accepted. There are often redundancies between primary and companion codes; in these instances, references to the primary codes are stated.

4.1.1 Primary Codes

Table 4-1:
Primary codes reviewed for the Silfab facility

Code / Standard	Title	Version
SCBC	South Carolina Building Code (IBC)	2021
SCFC	South Carolina Fire Code (IFC)	2021

4.1.2 Companion Codes

Table 4-2:
Companion codes reviewed for the Silfab facility¹, sorted by relevance

Code / Standard	Title	Version
NFPA 1	Fire Code	2024
NFPA 400	Hazardous Materials Code	2025
NFPA 55	Compressed Gas and Cryogenic Fluids Code	2023
NFPA 704	Standard System for the Identification of Hazardous Materials for Emergency Response	2022
ASME B31.3	Process Piping	2024
ASME BPVC VIII	Boiler and Pressure Vessel Code	2023

¹While NFPA 318 specifically addresses semiconductor fabrication facilities, it is not referenced by either SCFC or SCBC and is therefore in the discretion of the Authority having Jurisdiction (AHJ) for applicability.

Table 4-3:
Additional standards adopted as code by the primary and companion codes, sorted by relevance

Code / Standard	Title	Version
CGA G-13	Storage and Handling of Silane and Silane Mixtures	2016
ASME A13.1	Scheme for the Identification of Piping Systems	2023
CGA S-1.1	Pressure Relief Devices – Cylinders	2020
CGA S-1.2	Pressure Relief Devices – Portable Containers	2020
CGA P-74	Standard for Tube Trailer Supply Systems at Customer Sites	2024

4.2 Chemical Hazard Classification for Chemicals of Interest

NFPA 704 and NFPA 400 address hazardous materials from different but complementary perspectives. NFPA 704 assigns a health hazard rating on a scale of 0 through 4 for emergency response purposes, whereas NFPA 400 is a hazardous materials code used to classify materials by hazard category for storage, use, handling, and protection requirements, including health-hazard classes such as corrosive, toxic, and highly toxic materials, and physical hazard classes such as flammable, oxidizing, unstable reactive, water-reactive, and pyrophoric materials. Both NFPA 704 and NFPA 400 hazard classifications are referenced in the code to prescribe controls like secondary containment, separation distances, detection, and other design safeguards associated with the hazardous material class. The hazard classifications for the Chemicals of Interest are provided in Table 4-4.

Table 4-4:
NFPA 400 chemical hazard classes for examined chemicals, NFPA 704 health-hazard rating,
and IFC Toxicity Rating

Chemical	NFPA 400 Primary Hazard	NFPA 400 Secondary Hazard	NFPA 400 High-Hazard Class	NFPA 704 Health- Hazard	IFC Toxicity
Ammonia, Anhydrous (NH ₃)	Toxic	Corrosive	4	3	Toxic
Hydrochloric Acid, 37% (HCl)	Toxic	Corrosive	4	3	Toxic
Hydrofluoric Acid, 49% (HF)	Toxic	Corrosive	4	4	Highly-Toxic
Potassium Hydroxide, 45% (KOH)	Corrosive	n/a	4	3	Toxic
Silane (SiH ₄)	Pyrophoric	Toxic	2	1	Non-Toxic

4.3 Design Documentation

A review of the applicable design documentation provides awareness of which code standards were used for designing the applicable systems. Design documentation from the architect, MCA Architecture, equipment vendors like Praxair and ProChem, and gas suppliers like Linde were included in this review. Table 4-5 summarizes the design documentation reviewed by TRC for the distribution systems associated with the Chemicals of Interest.

During TRC's review, some inconsistencies in the design documentation were found and these inconsistencies are presented in Section 4.6.

Table 4-5
Design documentation received¹ for review

Design Document	NH ₃	SiH ₄	HF	HCL	KOH
Process Design Basis (DB)	✓	✓	✓	✓	✓
Process Flow Diagrams (PFDs)	✓	✓	✓	✓	✓
Piping and Instrumentation Diagrams (P&IDs)	✓	✓	✓	✓	✓
Piping Plans (PP)	✓	✓	✓	✓	✓
General Arrangements (GA)	✓	✓	✓	✓	✓
Pipe Service Index (PSI)	✓	✓	✓	✓	✓
Piping Specifications	✓	✓	✓	✓	✓
Pipe Pressure Testing Pressures/Procedures	✓	✓	✓	✓	✓
Pipe Support Schedule	✓	✓	✓	✓	✓
Electrical Area Classification Documentation	✓	✓	n/a	n/a	n/a

¹ A check "✓" indicates design documentation was available for review. An "X" indicates design documentation was not available for review.

Piping and Instrumentation Diagrams (P&IDs) provided for the liquid chemical distribution and wastewater treatment systems should be further developed to align with the level of detail typically expected for P&ID drawings. This includes showing control loops where appropriate and clearly documenting the location and setpoints for tank blanketing valves and safety devices, such as pressure relief and leak detection. Silfab was able to provide some additional documentation for the control logic for safeguards in the chemical storage system that were not identified on the P&IDs.

4.4 Code Compliance

Table 4-6 is a code compliance matrix for the distribution systems related to the Chemicals of Interest at the Silfab facility. Duplicated requirements in the code are not repeated in Table 4-6. Code compliance was evaluated by (a) design documentation, (b) physical inspection, or (c) photographs.

Table 4-6
Code Compliance Matrix¹

Code	Line	Requirement	NH3	SiH4	HF	HCl	KOH
SCFC	2703.2.3.2	Welded piping for chemicals rated health-hazard 3 or 4	✓	✓	✓	✓	✓
SCFC	2703.2.3.2	Ventilated Enclosure for gas	✓	✓	n/a	n/a	n/a
SCFC	2703.2.3.2	Drainage on valve boxes for liquids	n/a	n/a	✓	✓	✓
SCBC	[F] 415.11.7.3	Excess flow control on services greater than 15 PSI	✓	✓	✓	✓	✓
SCBC	[F] 415.11.7.4(3)	Secondary containment on liquid pipe	n/a	n/a	✓	✓	✓
SCBC	[F] 415.11.7.5	Piping Identification	✓	✓	✓	✓	✓
SCBC	[F] 415.11.8.2.2	Gas-Detector Automatic Supply Shutoff, see also CGA G-13 6.4.1.2 and 11.1.5 for Silane	✓	✓	✓	✓	n/a
SCFC	5003.2.2.1(4)	Access and Labeling of Emergency shutoff valves	✓	✓	✓	✓	✓
SCFC	5003.2.2.1(5)	Backflow prevention	✓	✓	✓	✓	✓
SCFC	5003.2.7	Liquid level limit control	n/a	n/a	1	1	1
SCFC	5003.9.8	Separation of incompatible material	✓	✓	✓	✓	✓
SCFC	5003.12(2)	20' of separation between outdoor control area and lot line	✓	✓	✓	✓	✓
SCFC	5004.2.1	Spill control to contain contents of largest vessel	n/a	n/a	✓	✓	✓
SCFC	5004.2.2	Secondary containment for corrosive or toxic liquids	n/a	n/a	✓	✓	✓
SCFC	5004.2.2.5	Secondary containment monitoring	✓	✓	✓	✓	✓
SCFC	5303.3.2	Pressure relief devices on bulk gas containers	✓	✓	n/a	n/a	n/a
SCFC	5803.1.3	Ammonia emergency shutoff at source and point of use	✓	n/a	n/a	n/a	n/a
SCFC	6003.1.3	Exhaust scrubbers for processing vapors of highly-toxic liquids shall be provided where a spill or accidental release can be expected.	n/a	n/a	n/a	n/a	n/a

**Table 4-6
Code Compliance Matrix¹**

Code	Line	Requirement	NH3	SiH4	HF	HCl	KOH
SCFC	6004.1.3	Exhausted enclosures for toxic or highly toxic gases	✓	✓	n/a	n/a	n/a
SCFC	6004.2.2.7	Exhaust ventilation treatment systems from exhausted enclosures for toxic gases need to be sized to handle the worst-case release of gas	✓	n/a	n/a	n/a	n/a
SCFC	6004.2.2.10.3	Automatic shutoff of ammonia	✓	n/a	n/a	n/a	n/a
SCFC	6004.3.2.1.1	75' between gas storage and lot line or public way	✓	✓	n/a	n/a	n/a
SCFC	6004.3.2.1.3	75' between gas storage and building air intakes	✓	✓	n/a	n/a	n/a
SCFC	6004.3.2.1.3	75' to openings in buildings (as defined by SCBC 707.6 as a discontinuity in the fire-barrier). 50' if there is a fire barrier between the storage area and the opening.	✓	✓	n/a	n/a	n/a
SCFC	6403.1.1.1	Silane remote source shutoff greater than 15' from tank, see also CGA G-13 6.4.1.1.	n/a	✓	n/a	n/a	n/a
SCFC	6403.1.1.2	Emergency shutoff at point of use	n/a	✓	n/a	n/a	n/a
SCFC	6404.2.1	Silane separation distances per CGA G-13	n/a	✓	n/a	n/a	n/a
NFPA 55	6.20.2	Source valve shall be identified on drawings	✓	✓	n/a	n/a	n/a
NFPA 55	7.7.2.6	Confirm PRVs vent away from weather protection	2	n/a	n/a	n/a	n/a
NFPA 400	21.3.9.3.2.1	Gas detection on VMBs and other enclosures for toxic gas, e.g. ammonia	3	n/a	n/a	n/a	n/a
NFPA 704	NFPA 704	Hazardous Material Identification (NFPA Diamond)	✓	✓	✓	✓	✓
CGA G-13	6.3.2	80' to property lines for silane	n/a	✓	n/a	n/a	n/a
CGA G-13	6.4.3.2.1	2-hr fire wall between bulk sources and BSGS panel	n/a	✓	n/a	n/a	n/a
CGA G-13	10.2.1	Packed valves shall not be used for silane	n/a	✓	n/a	n/a	n/a
CGA G-13	10.2.4.2	Restrictive flow orifice on bulk container. The RFO should be <0.125" in diameter.	n/a	✓	n/a	n/a	n/a
CGA G-13	11.1.5.1	Gas detection on VMBs for silane	n/a	4	n/a	n/a	n/a
CGA G-13	11.2.1	Flame detection on outdoor systems	n/a	✓	n/a	n/a	n/a
CGA G-13	12.2.1	Deluge system for outdoor bulk silane storage	n/a	✓	n/a	n/a	n/a
CGA G-13	13.2.3	System airflow for exhausted enclosures should be 250x the maximum silane flow rate	n/a	✓	n/a	n/a	n/a
CGA G-13	13.2.4	Exhaust from VMBs and exhausted enclosures shall be monitored to detect a failure in the ventilation system	n/a	✓	n/a	n/a	n/a
CGA G-13	14.3	Silane treatment systems shall be designed for the use intended and shall have the capacity to treat the flow under upset conditions	n/a	✓	n/a	n/a	n/a

Table 4-6
Code Compliance Matrix¹

Code	Line	Requirement	NH3	SiH4	HF	HCl	KOH
CGA P-74	7.2	Hose specifications for transfer trailer	✓	✓	n/a	n/a	n/a
ASME B31.3	301.2.2 & 322.6.3	Location of pressure relief. The design of pressure relief valves shall be in accordance with ASME BPVC or DOT. Pressure relief of gases should be directed to treatment systems.	✓	✓	5	5	5
ASME B31.3	345.1	Leak testing for secondary containment	✓	✓	n/a	n/a	n/a
API 2000 / ASME BPVC VIII		Pressure relief sizing on storage tanks / trailers	✓	✓	n/a	n/a	n/a

¹ A check "✓" indicates the design meets code. A numeric value, e.g., 1,2,3, indicates design does not meet code or information about design is missing and makes reference to action items in table 4-7. "n/a" means that the code does not apply to this system.

4.5 Discussion

This section documents observations regarding the facility design. The information shared in this section should not be construed as providing design services, design direction, or design recommendations.

The facility in which Silfab is located was evaluated for compliance with the following codes and standards. It is important to note the following summary of those codes and standards is for summary information purposes and where the codes and standards conflict or are not consistent with these summaries, the codes and standards govern, and the facts cited in each summary have not been field verified.

4.5.1 SCBC [F] 415.11.7.3

South Carolina Building Code, Section 415 covers H-1 through H-5 occupancy. When Hazardous Production Material (HPM) is transported via pipe at pressures greater than 15 psig, an excess flow control device may be warranted at the source. HPM sources in an H-5 classified area are required to have excess flow control devices.

The Phase 1 buildout of the main production area (Control Area 1) did not use chemicals exceeding the Maximum Allowable Quantities (MAQ) which would trigger an H-5 classification, but some chemicals were close to the threshold. Any expansion plans for the Control Area 1 should be evaluated for the potential to exceed the MAQ which would trigger additional requirements for the area.

4.5.2 SCFC 5003.2.7

Atmospheric tanks with capacity greater than 500 gallons and which contain hazardous materials shall be equipped with a liquid level limit control. Per Silfab operating procedures,

liquid chemical storage tanks were provided with overfill protection, but it was not clear on the P&IDs. The P&IDs provided showed liquid level measurement on the bulk liquid chemical supply tanks but did not show details for controls or interlocks.

4.5.3 NFPA 55 7.7.2.6

NFPA 55 regulates the use of compressed gas and is often referenced by fire code and other NFPA codes. NFPA 55 7.7.2.6 requires that pressure relief valves on bulk storage containers be directed away from the covered weather enclosure, if present. Isotainer trailers and bulk gas tube trailers serve as the bulk storage containers for anhydrous ammonia and silane, respectively, at the facility. TRC was able to confirm that the anhydrous ammonia container was equipped with a pressure relief device supplied by the bulk-gas supplier that vents inside the weather enclosure. Per documentation provided by Linde, there was not a pressure relief device on the silane tube trailer.

4.5.4 NFPA 400 21.3.9.3.2.1/ NFPA 55 7.10.3.2.1.2.

The NFPA 400 standard includes the NFPA requirements for hazardous materials and is a companion to the SCFC. NFPA requires gas detection on equipment enclosures that handle hazardous gas to have a monitor at the point of discharge from the gas cabinet or exhausted enclosure. While the facility review showed the presence of an area toxic gas monitoring system, TRC did not observe gas monitors on the Valve Management Boxes (VMBs) or Bulk Gas Supply Systems (BSGS) panels “at the point of discharge” for the anhydrous ammonia distribution systems.

4.5.5 CGA G-13 11.1.5.1

CGA G-13 requires gas monitoring devices in ducts serving VMBs and exhausted enclosures for silane systems. The setpoint for the alarm must be at a silane concentration of 50 ppm or less. At the time of the on-site field review, Silfab did not have gas monitoring devices/systems in the exhaust ducts for the silane enclosures.

4.5.6 ASME B31.3 301.2.2 & 322.6.3

ASME B31.3 regulates the installation of process pipe. The silane, ammonia, HF, HCl, and KOH piping systems at the facility were considered “Normal” fluid service, as defined in this standard. ASME B31.3 301.2.2 requires pressure relief devices if there is a scenario where process conditions are greater than the rated maximum allowable working pressure (MAWP) of the pipe. Drawing MP-004ABC from the permitting drawing set indicated that the design pressure for the silane system was 120 psig and the ammonia system was 125 psig. The ammonia delivery pressure was less than that of the piping. There was a double regulator system on the silane delivery system to reduce the risk of overpressure.

Drawing MP-004ABC from the facility's permitting set indicated Silfab specified and approved pneumatic "pressure testing" for the liquid distribution piping at 50 psig. According to ASME B31.3 Chapter 6, pneumatic pressure testing is to occur at 1.1 times (i.e., 110%), the design pressure. Based on the pneumatic "pressure testing" at 50 psig, the "design pressure" for perfluoroalkoxy (PFA) pipe was 45 psig. There were no pressure relief devices shown in the drawings for the liquid distribution system, and none were observed on this system during the on-site field review performed by TRC.

As a best practice, TRC recommends that a HAZOP study be performed for the systems managing the Chemicals of Interest that includes an investigation and documentation of possible conditions for an overpressure scenario and the corrective actions to be taken.

4.5.7 ASME B31.3 345.1

Per ASME B31.3 345.1(d), pressure testing is not required on secondary containment pipe draining to a contained area at ambient conditions. Although not required, TRC recommends function tests of the secondary containment pipe to verify there are no leaks prior to placing them in operation.

4.6 Recommendations

Based on our evaluation of each system associated with the Chemicals of Interest, Silfab should address the following:

Table 4-7:
Recommended actions for code compliance & best practices

Table 4-6 Ref #	Code Reference	Recommendations for Chemicals of Interest	Systems Affected
1	SCFC 5003.2.7	Update P&IDs for the bulk liquid chemicals to show overfill protection and details for safety devices (e.g, pressure relief, leak detection monitors, etc.).	HF, HCl, KOH
2	NFPA 55 7.7.2.6	Confirm vents from tube trailers and fixed storage systems under weather protection discharge outside the weather protection.	SiH ₄ , NH ₃
3	NFPA 400 21.3.9.3.2.1	Install detection monitors at BSGS panels and VMBs for ammonia in the exhaust system.	NH ₃
4	CGA G-13 11.1.5.1	Provide gas monitoring in the silane BSGS and VMB exhaust system.	SiH ₄
5	ASME B31.3 301.2.2	Update drawings to show the location and setpoints of pressure relief devices in the liquid distribution system or document that the liquid distribution system is inherently safe in the absence of pressure relief.	HF, HCl, KOH
6	Best Practices Consideration	Conduct a HAZOP study to determine if and where pressure relief devices are required.	SiH ₄ , NH ₃ , HF, HCl, KOH
7	Best Practices Consideration	Standardize P&IDs for the chemical storage, chemical distribution systems and wastewater treatment system.	HF, HCl, KOH
8	Best Practices Consideration	Perform a function test of the secondary containment piping for liquid service to verify it is not leaking prior to placing in service.	HF, HCl, KOH

Section 5

Leak Prevention and Response - Construction Documentation

5.1 Construction Documentation

ASME B31.3 requires construction documentation be established and maintained regarding the design, materials, certifications, inspection, examination, and qualifications for process piping systems. Table 5-1 shows the status of the construction documentation obtained by TRC for the facility that was required by ASME B31.3. Some of the documentation in Table 5-1 was required to be maintained for five years, such as the examination procedures, examination personnel qualifications, and the examination reports.

Table 5-1
Required Construction Documentation¹

Code	Line	Document	NH3	SiH4	HF	HCL	KOH
Material of Construction			316 SS		PFA		
ASME B31.3	n/a	Design Basis Document	✓	✓	✓	✓	✓
ASME B31.3	328.1	Welder Qualifications	✓	✓	n/a	n/a	n/a
ASME B31.3	U328.2	Welding procedures for gas-tungsten arc welding for high-purity service	✓	✓	n/a	n/a	n/a
ASME B31.3	340.2	Inspection verification or inspection report from owner or owner's representative	✓	✓	✓	✓	✓
ASME B31.3	341.3.2	Acceptance criteria for pipe weld examination	✓	✓	n/a	n/a	n/a
ASME B31.3	341.4.1	Examination for normal fluid service	✓	✓	✓	✓	✓
ASME B31.3	341.5.1	Radiography reports	✓	✓	n/a	n/a	n/a
ASME B31.3	345.2.7	Leak test reports	✓	✓	✓	✓	✓
ASME B31.3	345.5	Pressure testing procedures and results for secondary containment pipe	✓	✓	n/a	n/a	n/a
ASME B31.3	346.3(a)	Examination procedures	✓	✓	✓	✓	✓
ASME B31.3	346.3(b)	Examination personnel qualifications	✓	✓	✓	✓	✓
ASME B31.3	346.3(c)	Examination reports	✓	✓	✓	✓	✓
ASME B31.3	A302.2.3	Piping pressure/temperature certification for unlisted materials	n/a	n/a	✓	✓	✓
ASME B31.3	321.1.2	Pipe support schedule	✓	✓	✓	✓	✓
ASME B31.3	U306.6	Tube fitting specifications for high-purity service	✓	✓	n/a	n/a	n/a

¹A check "✓" indicates design documentation was available for review. An "X" indicates design documentation was not available for review.

5.2 Discussion

The documentation listed in Table 5-1 was documentation required by ASME B31.3 for process piping. Silfab was able to provide all the required construction documentation per ASME B31.3.

5.3 Recommendations

Silfab, their architect, and their contractors appear to have met the documentation requirements for ASME B31.3.

Note that TRC did not review construction documentation for the bulk storage tanks for KOH, HCl, and HF as there was not a mandated construction standard; however, the information from the manufacturer of the tanks (Poly Processing) indicated they were likely constructed to meet the requirement of American Society for Testing and Materials (ASTM) D-1998: Standard Specification for Polyethylene Upright Storage Tanks. The tank manufacturer had specific instructions for installation and testing (i.e., 24-hour hydrostatic test) of the tanks prior to placing them in operation. Silfab should verify and document that the tanks were constructed to the ASTM D-1998 standard and were installed and tested in accordance with manufacturer recommendations before placing them in operation.

Section 6

Leak Prevention and Response – Operations

6.1 Operating Procedure Leak Evaluation

Silfab provided TRC with copies of standard operating procedures (SOPs), Process Safety Information (PSI), and operator training documentation related to the Chemicals of Interest for evaluation. These documents were reviewed by TRC to assess:

- The actions taken at the facility for the prevention of leaks (e.g., checks performed while the system is running, operating procedures that must be followed to prevent leaks, etc.).
- The actions and timing to address any leaks or spills discovered during operation, maintenance, inspection, or system downtime.
- The documented training program materials and scheduled training sessions that operators and site management receive regarding leak prevention and response methods and procedures.

The SOPs listed in Appendix E were assessed for the inclusion of steps to evaluate, detect and respond to leaks and spills related to the Chemicals of Interest during normal operation, startup, shutdown, and upset conditions. SOPs were maintained and managed in the GembaDocs (a document management program used for document control for version management, managerial review and approval) and consisted of two levels, primary and secondary. The primary SOP existed as a “directional” document that provided overall purpose of the procedure and the basic equipment detail, often with list-driven procedures or links to more detailed secondary procedures with pictures and examples. Primary procedures were typically named for the intended scope (“Unloading to the VMBs”) or for a specific tool (a tool being a supplied piece of processing equipment with internal components for specific purpose) and did not typically include pictures or equipment tag names to support the understanding of the procedures.

SOPs assessed during this evaluation included the following sections:

1. Purpose
2. Scope
3. Responsibility
4. Abbreviations
5. Machine Identification and Technical Data (if appropriate)
6. Process Modules and Chemical Hazards (if Machine Identification is included)
7. Operating Procedures
8. Normal Shutdown and Idle (for Process Tools)

9. Emergency Shutdown and Response
10. Operating Limits and Alarms
11. Reference
12. Revision Log
13. Daily Checklist as an Appendix A

The Process Modules section of each SOP listed the process chemicals, the hazards and required precautions, safety devices and systems [e.g., Toxic Gas Monitoring Systems (TGMS), nitrogen purges, pressure regulators, ventilation, emergency stop (E-Stop) buttons] and personal protective equipment. Typical verbiage stated to press an E-Stop if:

- Leaks are detected on equipment or there is spraying from process pipe.
- TGMS systems are alarming.

The Operating Procedures section of each SOP contained general process steps (e.g., Power On, Startup, Normal Operation, Idle, Shutdown, and Emergency Shutdown) with either discrete steps or a link to a secondary, supporting procedure with detailed steps, pictures, and operating parameters. Secondary procedures typically included work instructions for initial power-on of equipment, normal startup, and normal shutdown with pictures of equipment, valves, and human-machine interface (HMI) screens. These secondary operating procedures were typically named for the operation being performed (i.e., “<Tool or area> <chemical if applicable><Purpose> <version number>”). Specific secondary procedures identified associated equipment that must be functioning to perform the work instruction. A “Training History” section with the name(s) of operators and their training date was included for those secondary procedures where training had been completed.

The Emergency Shutdown and Response section of each SOP included shutdown triggers (e.g., smoke/fire alarms, chemical leakage, TGMS alarms, power failure, or truck unloading emergency) with actions to be taken by operators, supervisors, and other facility personnel.

The Operating Limits and Alarms section of each SOP listed discrete components with intended limitations of volume / inventory, temperature, pressure, flow, or other relevant parameters. The Alarms table in this section showed the color of each alarm indicator, its meaning, and required action.

Typical SOPs included a pre-start checklist in Appendix A of each SOP to be completed at the beginning of each shift. These checklists included visual inspections of hoses, valves, piping, tanks, and shipping containers for evidence of leaks. If there was associated equipment that must be functioning to perform specific tasks, the SOP indicated which pieces of equipment would be checked for online status (e.g., air compressors or air abatement equipment).

The typical instruction for the discovery or observation of leakage and spills of applicable Chemicals of Interest was for the operators to shut down the applicable process equipment in the immediate area.

For HF, HCl, KOH, ammonia, and silane, the prescribed action was for the operator to shut down by initiating a local E-stop and closing feed valves if safe to do so, then evacuate the area. Following the initiation of emergency shutdown procedures, the response would be managed by the emergency response team (ERT), safety group, and/or the process area supervisor. An evaluation of the response methods and procedures is provided in Section 8 of this report.

Toxic Gas Monitoring System

In addition to the Fire Alarm System, the facility had installed a Toxic Gas Monitoring System (TGMS) that consisted of a network of RKI GD-70D monitors with sensors installed for monitoring oxygen, HF, HCl, silane, and ammonia. The installations were reportedly provided with uninterrupted power supplies and included the following locations (per “Silfab SC Network Layout Design V7_TGMS Markup_rev 3-11-26.pdf”):

- three silane monitors in the silane storage area outside,
- one ammonia monitor in the ammonia storage area outside,
- two oxygen monitors in maintenance corridor,
- one HF monitor and one HCl monitor in the graphite boat room,
- two silane monitors and one ammonia monitor in the coatings area,
- one oxygen monitor in the passivation and ARC area,
- one HF monitor and one HCl monitor in the Poly Etch area,
- one oxygen monitor, one silane monitor and one HCl monitor in the Poly area,
- one HF monitor and one HCl monitor in the Rear Polish area,
- one oxygen monitor and one HCl monitor in the emitter area,
- one HF monitor and one HCl monitor in the texture area,
- one HF monitor and one HCl monitor in the acid storage room, and
- one oxygen monitor in the WWTP area.

The installations were for general area monitoring in proximity to equipment, piping and manifolds; no direct monitoring of the secondary containment piping with gas sensors was observed.

6.1.1 Liquid Acids: Hydrofluoric Acid (HF) and Hydrochloric (HCl)

Unloading

The facility’s SOPs detailed the steps for unloading an isotainer of HF solution and a trailer of HCl solution to bulk tanks inside the HF/HCl bulk storage room and how to select the appropriate destination tank. The instructions required monitoring of the receiving tank level on the local

HMI to confirm that the tank level did not exceed 80% of the maximum fill level. The connection was performed by the delivery driver and required the attendance of a Silfab employee per the procedure.

The primary action was to close the outlet valve on the delivery trailer or isotainer if a leak was detected during unloading by visual observation. The general procedures stated that after identification of the leak source, operators were to perform corrective actions and resolve per the SOP for Removing Material from Truck Unloading Sump Area. The facility should consider providing more guidance in the SOPs in reference to spill volumes, cleanup procedures and referring operators directly to the ERT for spill response for consistency with the facility's emergency response procedures.

Connection to the delivery vessels was to be via Silfab-provided hoses. Pipe from the unloading pad cabinet to the bulk storage room was double-wall polyvinylidene fluoride (PVDF). Silfab represented that leaks from the primary piping into the annular space would flow to the containment cabinet housing the PFA unloading air-operated diaphragm (AODD) pump. The containment box for the truck unloading pump had leak detection sensors to detect the presence of liquid from a spill or leak. The P&IDs did not provide sufficient details about alarms or interlocks associated with this system. The P&IDs for the liquid chemical distribution and wastewater treatment systems should be further developed to align with the level of detail typically expected for P&ID drawings, including showing control loops where appropriate. A table of interlocks was provided showing the control logic for safeguards.

Per construction documentation drawing A-101B, the volume of the isotainer unloading area sump was sized for 6,000 gallons, the approximate capacity of an isotainer load. The isotainer unloading area sump was required to be inspected per a specific checklist, and an SOP for removing material from the sump was in place for operators to follow for removal of rain or spillage.

Silfab represented the automatic interlocks listed in the SOP for the bulk storage tanks were related to the TGMS and fire alarm in the HF/HCl bulk storage room; however, the SOP did not detail the sequencing of automatic controls during an emergency shutdown. Should maximum inventory of the storage tanks be reached, the unloading operation would stop, per the SOP; however, there was discrepancy in the documentation on the control for this safeguard. A HAZOP study should be considered to identify control systems and safeguards and assure that safety interlocks provide the intended protections.

The HMI at the truck unloading pad was difficult to view due to its location relative to sunlight. The facility should consider providing shade/protection for the HMI screen, relocating it, or adding an additional HMI screen in another location that does not receive direct sunlight.

Bulk Storage and Distribution

Liquid acid storage and distribution to the facility was to occur in the HF/HCl bulk storage room with area monitoring of HF and HCl via the TGMS system located on the wall of the room. Work instructions outlined the selection of the respective source tank to feed the chemical dispensing unit (CDU) and the conditions under which each acid was to be circulated back to the source tank and/or delivered to the clean room tools for usage. Distribution of acid(s) reportedly begins with the opening of the primary isolation valve on the tank to a valve box that included inline secondary valves to the respective CDU and an outlet valve to assist in tank draining for maintenance. Information provided by Silfab indicated the tanks were provided by PolyProcessing Solutions and were fabricated from cross-link polyethylene (XLPE), with 8,500 gallons capacity for the HF tanks and 5,300 gallons for the HCl tanks. Each tank was constructed with a cylindrical vertical design with domed top and flat, non-sloped bottom. The tanks were located in a room with a recessed concrete floor with an epoxy coating which Silfab represented as resistant to hydrofluoric acid. The room was capable of providing at least 15,000 gallons of containment according to information provided by Silfab. Each tank was rated for atmospheric pressure and had a nitrogen blanket set from 2 to 3 inches of water column. Exhaust piping was observed to route emissions to the packed bed scrubber. Each tank exhaust was equipped with a conservation vent set to relieve at +/- 3 inches of water column during normal operation. The positive side of the conservation vent was piped to the scrubber for control of emissions while the vacuum breaker side of the conservation vent would allow ambient air into the tank to relieve vacuum pressure. The tanks vents also had a valve and piping to allow for bypass of the conservation vent to the scrubber as needed. No other pressure relief was observed on the tanks.

TRC observed that the tank systems were not designed to be completely emptied leaving a heel of material in the tank just below the lowest flange on the sidewall of the tank. TRC also observed that the tank systems were not designed to accommodate transfer of material from the storage tanks to a tanker or other container for transport offsite, if needed. The facility should consider modifying the tank systems (e.g., siphon tube) to allow for each tank to be completely emptied to the extent practicable for future inspections and maintenance activities. Any future tank installations should consider use of slope bottom or other designs to allow for the tanks to be completely drained. The facility should also consider providing a method for safely offloading material from the tanks to a tanker truck while controlling emissions (e.g., vapor balance), if needed.

After the valve box, the acids were piped to the respective CDU where it would be pumped for recirculation and chemical delivery via an AODD pump. The CDUs were packaged units with two PFA pumps and filter pairs mounted inside a containment cabinet (materials of construction for the cabinet were not marked or noted); manual valves were present in the CDU to select the active delivery pump and filter. The CDUs were controlled by PLC and an HMI that the operator

was to use for input and process monitoring. Once activated, HF was to be supplied to the eight VMBs and HCl to seven VMBs that supply the different wet tools in the clean room.

Primary leak protection was to occur via the piping system. The piping was double-wall rigid PVDF from the bulk tanks to the CDU; the inner piping was welded PVDF and appeared clear while the outer secondary containment piping appeared slightly opaque. After exiting the pump and filter in the CDU, the acids would be transported via flexible PFA tubing (one solid piece from valve-to-valve) contained in a rigid, clear PVC secondary pipe for ease of inspection. Silfab represented that leaks from the primary piping into the annular space would flow back to the CDU containment cabinet or to the VMB.

There were several forms of automatic monitoring observed in the bulk storage area that could aid in leak detection. Silfab indicated HF and HCl area monitoring in the HF/HCl bulk storage room included a high vapor concentration alarm setpoint of 3 ppm for HF and 1 ppm for HCl to initiate corrective actions to be taken by operations. There was a high-high HF vapor concentration alarm setpoint of 6 ppm and a high-high HCl concentration of 5 ppm that would initiate the fire alarm, provide notification to the fire department, and prompt facility evacuation. Equipment packages denoted level switches in the CDU cabinets that would detect if material leaked into the cabinet but the P&IDs did not show this instrumentation. The P&ID should be updated to include these switches. An area E-stop was observed on the HMI cabinet in the bulk storage room.

Transfer piping from the HF/HCl bulk storage room was routed outside and into the maintenance corridor interior with an additional aluminum clad shield for UV protection of the section of pipe runs located outside. In the maintenance corridor, these piping lines branched off into separate delivery piping connections for the clean room VMBs. The piping line inspection checks were included in the SOP daily checklist documentation. There were no TGMS monitors for HF or HCl observed in the maintenance corridor during the evaluation.

At the time of the on-site assessment, one storage tank at the facility was being used for active storage of 49 weight percent HF held under a nitrogen blanket.

Wet Tools & Graphite Boat Room

The wet tools are the “wetted process” portion of the process steps in the clean room. The various wet tools will process the silicon wafers within each tool or on a conveying system customized to each tool. The wet tools that will consume the acids are BatchClean, BatchEtch, BatchTexture, InEtchside, and InPolySide. These wet tools had chemical baths where the acids were to be diluted to specific concentrations based on each tool’s purpose. Batch processing would primarily flow from section-to-section and was customized to each tool. The tools were designed and intended to be fed and emptied with silicon wafers to and from each other by process robotics.

The facility also had a cleaning operation in a separate room (Graphite Boat Room) adjacent to the wet tool area where there was a process for cleaning the transport devices for different processes; these included the Boron Diffusion Quartz Boat Cleaner, Graphite Boat Cleaner, Low Pressure Chemical Vapor Deposition (LPCVD), Quartz Boat Cleaner, Quartz Tube Cleaner, and Wafer Rework Cleaner. These tools utilized HF and/or HCl. The graphite boats were to be utilized for managing silicon wafers as part of the process flow. The cleaning process would be performed in an enclosure similar to those used for the wet tools.

The respective acid distribution piping to the wet tools and the graphite boat cleaning process from the clean room VMBs was observed to be of double-wall construction. The piping leaving each VMB was routed overhead to the chemical feed portion of the tools. Silfab represented that a leak from the primary piping into the annular space would flow back to the VMB or into the tool enclosure. Each wet tool had a manual valve that was reportedly required to be opened to feed the acid(s) to the different portions of the tool that would utilize them. The clean room VMBs contained two level switches and a bulkhead fitting to drain any acid leaks to carboys (~5 gallons, unsealed) located below each VMB. The VMB cabinet was vented to the scrubber system. The connections between the VMBs and carboys should be secured, but any secured connection between VMBs and carboys should allow for vapor space connectivity.

TGMS monitors for the respective acids were located in the vicinity of the clean room VMBs and also in the Graphite Boat Room. TGMS alarms and VMB level alarms, along with corrective actions, were included in existing wet tool SOPs. The E-stop for each tool was observed on the HMI screen panel for the tool.

Inside the wet tools, the acid tubing continued in a double-wall system with tubing inside a rigid plastic pipe. Inside the tool, there were “overfull” and “leakage” sensors attached to process baths and safety pans. These sensor alarms were described in the SOP in a basic manner with instructions for various anticipated situations.

Once in the tool, acid dilution(s) would be achieved through the use of flow devices, level switches, and solenoid valves. After the wafers are batch processed through the baths to completion, the baths would be drained into box-sumps that act as lift stations. The vapor space of the lift station boxes was connected to the tool vapor space for vapor management. Silfab represented that depending on the dilution level, the lift stations would pump the spent acid bath batches through polypropylene (PP) piping that was either of double-wall construction and labeled “concentrated acid” (pH of ~2.6) or via single-wall pipe and labeled “dilute acid” (pH ~3.0) to the wastewater treatment system (WWTS). The concentrated acid piping was constructed of double-contained polypropylene material and sloped across the top of the clean room ceiling (but inside the shell of the manufacturing building) and exited the building towards the WWTS. The graphite boat cleaning processes featured a similar enclosure with baths and sumps for managing acid dilution and discharge of wastewater to the WWTS.

In the event of dilution automation failure, the continued use of polypropylene as a material of construction for wastewater transfer piping would need to be evaluated further. For automation, tool process baths, tool safety pans and associated lift stations had “leakage”, “pan”, or “overflow” alarms. The wet tool SOPs that were reviewed included interlock descriptions related to these alarms or how operators should respond if alarms are activated with instructions for various anticipated situations.

Ventilation and Air Pollution Control Devices

The vents from the acid bulk tanks, VMBs, CDUs, tool enclosures and graphite boat cleaning enclosure that would use the acids were connected to ductwork and routed outside of the building to a packed bed acid scrubber system provided by Monroe Environmental. The purpose of the packed bed scrubber was to neutralize acidic vapors in the exhaust utilizing a KOH solution as the scrubbant. The material of construction for the ductwork, packing, and scrubber housing was polypropylene and the piping, valves and pumps associated with scrubber operation were constructed of PVC and CPVC. The exhaust flow through the scrubber was controlled via induced draft fans (one online fan and one spare). The tank portion was level controlled with fresh-water makeup, blowdown to the WWTS was controlled by conductivity, and the pH was controlled through KOH addition. The overflow pipe was directed to the WWTS. There was no containment installed for the scrubber system at the time of the evaluation.

In the event of relief from the emergency vent or a spill into the HF/HCl bulk storage room, emissions would be directed to atmosphere via a roof vent. TRC was not provided with documentation of any methods or procedures for abatement of vapors that would result from an emergency relief or spill into the room. Silfab should evaluate options for mitigating emissions from the HF/HCl bulk storage tank room in the event of emergency venting or significant spills. The options should consider potentially scrubbing vapors from the room to control emissions, if feasible.

Any vapors from spills or releases in clean room areas would be exhausted with the room air which was mostly filtered and recycled to the clean room with a smaller percentage exhausted to atmosphere above the roof. Emissions from a spill or release in the maintenance corridor would combine with the general facility air in the main portion of the building where assembly occurs.

6.1.2 Potassium Hydroxide (KOH)

Unloading

The facility SOPs detailed the steps for unloading a tank trailer of aqueous KOH solution to a bulk storage tank inside the KOH bulk storage room and how to select the destination tank for the trailer’s contents. The instructions for the operators were to monitor the receiving tank

level on the local HMI to confirm the tank level does not exceed 80% of the maximum fill level. The facility also received shipments of potassium hydroxide in Intermediate Bulk Container (IBC) totes for use in the scrubber system. The totes of KOH solution for the scrubber were also stored in the KOH bulk storage room at the time of the evaluation.

The primary action was to close the outlet valve on the delivery tank trailer if a leak was discovered during the unloading process. If a leak was observed, the general procedure stated that after identification of the leak source, the operators were to perform corrective actions to stop the leak and neutralize the KOH spill.

The KOH tank trailer connection to the bulk storage tank was made using a Silfab-provided hose. Pipe from the unloading pad cabinet to the bulk storage room was double-contained PVDF. Silfab represented that leaks from the primary piping into the annular space would flow to the containment cabinet housing the PFA unloading AODD pump. The containment box for the truck unloading pump reportedly had leak detection sensors to detect the presence of liquid from a spill or leak; however, these were not depicted on P&IDs. Per the construction documentation provided to TRC, the volume of the truck unloading area sump was sized for 6,000 gallons. The truck unloading area sump was to be inspected per daily checklist, and spillage would be directed per the truck unloading sump SOP.

The SOP included references to audible/visual tank level alarms or other automatic interlocks that exist, restrictions on delivery volumes (due to the containment size) and delaying unloading due to weather events.

Bulk Storage and Distribution

KOH would be distributed to the facility from the KOH bulk storage tanks. Work instructions existed that outlined the selection of the source tank to feed the KOH chemical dispensing unit (CDU) and the conditions under which KOH would be circulated back to the source tank or delivered to the clean room tools that use KOH. Information provided by Silfab indicated the tanks are cross-link polyethylene (XLPE), 5,300 gallons each with closed top and flat, non-sloped bottom provided by PolyProcessing Solutions. The tanks were located in a room with a recessed concrete floor with an epoxy coating which Silfab represented as resistant to KOH. The room was capable of providing at least 15,000 gallons of containment according to information provided by Silfab. Each tank was rated for atmospheric pressure and had a nitrogen blanket set at 3 inches of water column. The tank exhausted to atmosphere inside the room and was equipped with a conservation vent set to relieve at +/- 3 inches of water. The distribution of KOH solution reportedly would begin with the opening of the primary isolation valve on the KOH storage tank to a valve box that included inline secondary valves to the CDU and an outlet valve to assist in tank draining for maintenance.

After the valve box, KOH was piped to the KOH CDU where material would be pumped for recirculation and chemical delivery. The KOH CDU had two pumps and filter pairs with manual valves to select the active delivery pump and filter. The CDU was controlled by PLC and an HMI that the operator would use for input and process monitoring. Once activated, KOH would be pumped to the valve manifold boxes (VMBs) that supply the different wet tools in the clean room. There was an E-stop observed on the control panel at the HMI in the KOH Bulk Storage Room.

Also in the storage area was a tote of 25% KOH solution with a metering pump that delivered the solution to the packed bed scrubber for acid exhaust gas neutralization. The KOH solution was transferred to the scrubber system in stainless steel tubing fed from a 150-gallon tote with a small metering pump.

Primary leak protection for the process tubing to the clean room was provided via the double-wall piping system. With the exception of the KOH transfer from the 150-gallon tote to the scrubber, the KOH piping was constructed of PVDF and double-wall design from the bulk tanks to the CDU; the outer piping appeared slightly opaque. After exiting the pump and filter in the CDU, KOH solution was transported via flexible PFA tubing, which was contained in a rigid, clear PVC secondary pipe. There was no documented instrumentation for the sumps in the bulk storage room to detect a leak or spill. The sumps were reportedly inspected daily using a checklist.

Equipment drawings denoted level switches in the CDU cabinet and the SOP described the function of these switches; however, the switches were not identified on the P&IDs. Silfab represented that leaks from the primary piping into the annular space would flow back to the CDU containment cabinet or to the VMB. TGMS monitoring was not provided for KOH storage and piping systems. Due to its low vapor pressure, there were minimal concerns with exposure to vapors from the use of KOH.

The transfer of KOH solution continued through the piping system from the KOH bulk storage room to the outside of the building through an additional aluminum clad shield while outside (for UV protection) and into the maintenance corridor interior where the piping continued in PFA tubing with secondary clear PVC rigid pipe. In the maintenance corridor, these pipelines teed for KOH delivery to the clean room VMBs.

Wet Tools & Graphite Boat Room

The wet tools are the “wetted process” portion of the process steps in the clean room, as described previously for HF and HCl. The wet tools that would consume KOH are BatchEtch, BatchTexture and InPolySide. These wet tools have chemical baths where the KOH solution will be diluted to specific concentrations based on each tool’s purpose. Batch processing would flow

primarily from section-to-section and was customized to each tool. The tools will typically be fed and emptied silicon wafers to and from each other by process robotic equipment.

The facility also had a cleaning operation in a separate room (Graphite Boat Room) adjacent to the wet tool area where there was a process for cleaning the transport devices for different processes: these included the LPCVD Quartz Boat Cleaner and Wafer Rework Cleaner. These tools utilized KOH. The cleaning process would be performed in an enclosure similar to those used for the wet tools.

KOH solution was distributed to the wet tools and the graphite boat cleaning process from the clean room VMBs via double-contained tubing. After exiting the VMB, the KOH piping was routed overhead to the chemical feed portion of the tools. Silfab represented that a leak from the primary piping into the annular space would flow back to the VMB or into the tool enclosure. Each wet tool had a manual valve that was required to be opened to feed KOH to the different portions of the tool that utilize KOH. The clean room VMBs contained two level switches and a bulkhead fitting to drain any KOH solution leaks into carboys (~5 gallons each, unsealed) located below each VMB. The connections between the VMBs and carboys should be secured, but any secured connection between VMBs and carboys should allow for vapor space connectivity.

VMB level alarms, along with corrective actions, were included in the existing wet tool SOPs. TGMS monitoring was not available for the KOH piping system; due to its low vapor pressure, there were minimal concerns with exposure to vapors from the use of KOH.

Inside the wet tools, the tubing continued in a double-wall system with tubing inside a rigid plastic pipe. Inside the tool, there were “overfull” and “leakage” sensors attached to process baths and safety pans. These sensor alarms were described in the applicable SOP. The E-stop for each tool was located at the HMI for each tool.

Once in the tool, KOH dilution would be achieved through the use of flow devices, level switches, and solenoid valves. After the wafers are batch processed through the baths to completion, the baths would be drained into box-sumps that act as lift stations. Silfab represented that depending on the dilution level, the lift stations will pump the spent KOH bath batches through PP piping labeled “dilute caustic to the WWTS.” Piping led up through the ceiling and from there was sloped across the clean room ceiling to the WWTS. The graphite boat cleaning process featured a similar enclosure with baths and sumps for managing HF dilution and discharge of wastewater to the WWTS. For automation, tool process baths, tool safety pans and associated lift stations had “leakage”, “pan”, or “overfull” alarms. The wet tool SOPs included interlock descriptions or how operators should respond to alarms with several anticipated scenarios.

6.1.3 Gases: Silane (SiH₄) and Ammonia (NH₃)

Trailer Storage and Unloading

Pressurized gas package units were provided by a vendor (e.g., Linde) in a supplied package solution for both silane and anhydrous ammonia. The package solutions included delivery vessels, individualized pressure reduction stations and distribution manifolds with custom vendor supplied controls and monitoring.

Trailer storage was provided on site for two tube trailers of silane and for two isotainers of ammonia. The storage area was sheltered under a metal structure and secured with galvanized chain-link fence with one keyed entrance gate and a separate panic-bar exit gate. For silane, each storage bay had concrete, 3-directional fire walls installed for fire and rapid expansion re-direction away from the production building and adjacent structures/equipment. Each storage bay was provided with infrared (IR) flame detection for larger leaks (due to the pyrophoric nature of silane) and a TGMS for detecting low concentrations of silane from small leaks. Connection to the trailer will be made by a stainless steel (SS) "pigtail."

The primary containment of the silane transfer piping was concentric, double-wall 316 SS, welded tubing. Area gas monitoring had a local indication alarm of 2.5 ppm silane, which would prompt corrective actions from operations. The higher alarm of 5 ppm would reportedly trigger a shutdown interlock on the Bulk Specialty Gas Supply (BSGS) monitoring system and summon the fire department. Silfab represented that the secondary containment pipe was maintained under vacuum pressure and was continuously monitored using pressure gauges for the detection of leaks from the primary piping. An E-stop was observed on the panel containing the HMI for the monitoring system.

For ammonia, the storage area was fenced in a chain link area sheltered under a metal roof. Trailers were parked on sump mounted scales (to monitor consumption) and were inspected as part of the daily checklist.

The trailer connection was an insulated doubled-walled SS tube that was heat traced for cold weather usage. This tubing was routed directly to the BSGS for the ammonia supply to the facility. Silfab represented the secondary containment pipe was maintained under vacuum pressure and was continuously monitored using pressure gauges for the detection of leaks from the primary piping.

The trailer storage area was monitored by a TGMS system for ammonia. A local indication alarm of 12.5 ppm would reportedly prompt corrective actions from operations and a higher alarm of 25 ppm would shut down the BSGS and summon the fire department. An E-stop was observed on the BSGS monitoring HMI panel during the site inspection.

Distribution

The piping will transfer material from the tube trailer to the production building side of the fire wall where it was observed to be routed to the BSGS. The BSGS is reportedly a monitored pressure reduction stand that will reduce the maximum truck pressure of silane gas from 1,752 psig to less than 138 psig. Silane will be conveyed from the BSGS into a distribution valve box (DVB) in the production building's maintenance corridor. The DVB is reportedly an engineered system provided by Linde for pressure stepdown that will reduce the silane pressure to approximately 60 psig before being conveyed to the clean room VMBs. Piping to and from the DVB was concentric 316 SS welded tubing. Silfab represented the secondary containment pipe was maintained under vacuum and was continuously monitored using pressure gauges for the detection of leaks from the primary piping. The DVB had an IR fire sensor for detection of leaks and fire. The E-stop for the DVB was observed on the panel monitoring the silane distribution system. Silane area monitors should be added in the maintenance corridor.

The ammonia BSGS was a monitored system that will reduce the ammonia pressure from 113 psig (maximum) to approximately 45 – 85 psig, reported as 73 psig in the Process Safety Information. From the BSGS, the ammonia piping was routed to the maintenance corridor in concentric, double-wall tubing wrapped in insulation and heat trace. Once inside the maintenance corridor, the tubing entered a DVB supplied by Linde for pressure stepdown. From the DVB, ammonia was piped into the clean room in double-wall welded tubing with insulation. Silfab represented that the secondary containment pipe was maintained under vacuum and was continuously monitored using pressure gauges for the detection of leaks from the primary piping. An E-stop was observed on the DVB HMI panel during the site inspection.

Hot Tools

The hot tools are the "hot gas process" portion of the process steps in the clean room where chemical vapor deposition (CVD) of silane and other additives will be reacted onto the surface of the silicon wafers. Silane from the clean room VMBs will be routed to the low pressure (LPCVD) and plasma enhanced (PECVD) tools for consumption, and ammonia will only be consumed in the PECVD tools. Both reactions are considered thin-film deposition methods used in semiconductor manufacturing where LPCVD uses thermal energy and PECVD uses plasma to drive chemical reactions. Batch processing for each tool will primarily occur in six tube furnaces that will act as reaction chambers. The tools will be typically fed silicon wafers and emptied to and from each other by process robotics. Internally, the tools contained flow meters and automated valves that would operate a set procedure for batch reaction recipes.

Both gases will be distributed via double-wall 316 welded tubing. Silfab represented the secondary containment pipe was maintained under vacuum and was continuously monitored using pressure gauges for the detection of leaks from the primary piping. Once the silane tubing left each VMB, it was routed overhead to the chemical feed portion of the tools. Each hot tool

had a manual inlet valve that reportedly must be opened to route silane from the VMB to the tool. Silane will be fed to the furnace tubes during the reaction step at pressures from approximately 45 to 85 psig according to the SOP; however, design documentation indicated the maximum pressure will be 60 psig. This SOP should be reviewed for accuracy against existing hot tool design documentation.

Each silane VMB was provided with IR flame detection. The area around the VMBs and hot tools was monitored by the TGMS system for silane and ammonia. Hot tool SOPs should include VMB IR flame detection, TGMS alarm values, or associated corrective actions prior to startup. The E-stop for each tool was observed on the panel located at the HMI for each tool.

Control Devices & Ventilation

After consumption of the silane in the LPCVD, the exhaust from the reaction tubes will be removed via vacuum pumps and conveyed from the vacuum pump exhausts with a nitrogen purge to the thermal oxidizer abatement system followed by a venturi scrubber and packed bed scrubber in series.

From the PECVD, the tool vacuum pumps will exhaust (with a nitrogen purge) to local plasma scrubbers (one per tool with some interconnection provided) located in the maintenance corridor. The DVB and VMB cabinets were also vented to the plasma scrubbers. The plasma scrubber outlets were routed through a common pipe to the thermal oxidizer followed by a venturi and packed bed scrubber via single wall, SS pipe.

Local plasma scrubbers were installed for each tool (6 PECVD tools total). The scrubbers were provided with interconnectivity in pairs (Scrubbers 1 & 2, 3 & 4, 5 & 6) by 3-way valves and piping for maintenance purposes. Interconnectivity and functionality of the 3-way valves should be reviewed prior to introducing gases to the process. Any vapors from releases in clean room areas would be exhausted with the room air which is mostly filtered and recycled with a smaller percentage exhausted to atmosphere above the roof. Emissions from a release in the maintenance corridor would combine with the general facility air in the main portion of the building where assembly occurs. As noted previously, Silfab should consider adding a TGMS monitor in the maintenance corridor.

6.1.4 Wastewater Treatment System

The wastewater treatment system (WWTS) will serve to provide physical-chemical treatment of the aqueous streams coming from the lift stations of the wet tools, sumps for acid and caustic storage rooms and the overflow and blowdowns from the venturi and acid scrubbers in the abatement area. The treatment scheme will consist of neutralization of the corrosive nature of the different feed streams in equalization tanks, coagulation and removal of precipitated solids

and suspended solids in a clarifier and canister filters, followed by discharge to the publicly owned treatment works (POTW).

The wastewater streams collected from the process areas will be conveyed through polypropylene piping to polypropylene and polyethylene tanks and finally processed in fiberglass reinforced plastic (FRP) tanks for final neutralization and coagulant feeds. These materials of construction should be reviewed for appropriateness should dilution failure occur in a tool using HCl or HF.

Supporting work instructions existed for startup, shutdown, and upset conditions: however, these work instructions did not address operating parameters, equipment alarms, or TGMS monitoring. These instructions should be reviewed with the OEM and updated for operational parameters and operational limitations to provide stepwise instructions for normal startup, shutdown, and upset conditions for the WWTS.

6.1.5 Air Pollution Abatement

Ventilation from the PECVD tools will be purged with nitrogen and routed to local plasma scrubbers for the first step of treatment to convert unreacted silane to silica (SiO_2). The exhaust piping was accumulated with the LPCVD tool stream exhaust piping and routed outside via stainless steel ductwork to a combination of a thermal oxidizer to convert any residual silane to silica and a water-based venturi scrubber to remove particulate.

Upon exiting the venturi scrubber, the exhaust piping was routed to the acid gas packed bed scrubber along with the exhaust piping from the wet tools. The acid gas scrubber used a solution of KOH as the neutralizer with pH control to remove acid gases from the exhaust prior to discharge to the atmosphere.

The exhaust flow from the tools and tanks will be maintained by variable-speed, induced draft fans on the feed and exhaust sides of the scrubber. After exiting the packed bed scrubber, the treated gas flow will be discharged from the vertical exhaust stack. This portion of the facility (oxidizer and scrubbers) were provided emergency backup power should there be a power outage. Continuous operation of this equipment would be critical for the entire wet and hot tool manufacturing processing.

Daily inspections of the abatement equipment and associated ductwork reportedly included visual checks for leaks and other operating issues. During TRC's on-site field review, there was no containment provided for the scrubber. It is recommended that a secondary containment system be added along with implementing routine inspections to prevent any leakage from the scrubber from reaching a stormwater conveyance.

Also, TRC observed that the piping associated with the scrubber did not have insulation or heat tracing to protect from freezing. Silfab should properly winterize the system to prevent potential leaks from piping failure due to freezing weather.

Supporting work instructions existed for startup, shutdown, and upset conditions: however, these work instructions appeared to be for initial startup and commissioning of the abatement equipment and did not address operating parameters, equipment alarms, or TGMS monitoring. These instructions should be reviewed with the OEM and updated for operational parameters and operational limitations to provide stepwise instructions for normal startup, shutdown, and upset conditions of the abatement equipment.

Operator Training

Operator training with training documentation had been initiated for several of the operating areas, including:

- Unloading
- Bulk storage
- Chemical distribution
 - HF
 - HCl
 - KOH
 - Ammonia
 - Silane
- WWTP
- Air Pollution abatement areas

This included training materials, training logs/sign-in sheets, and a documented means of verification that each employee could demonstrate they understood their responsibilities in operating the respective process.

Training material was under development for the wet tools and hot tools at the time of TRC's evaluation. Before commencing startup of the tools, operator training should be completed and documented with final training materials, training logs/sign-in sheets, trainer qualifications, and the means by which employee understanding of the operations was verified.

6.2 Observations and Recommendations

Table 6-1 below summarizes observations and recommendations from preceding subsections related to processes for the Chemicals of Interest. TRC included a column in this table for regulatory references and best practices. The inclusion of regulatory references does not necessarily indicate non-compliance. The PSM and RMP rules referenced are only applicable at this time for the storage of Silane and Anhydrous Ammonia. The regulatory references below for the other operations are provided for information purposes in anticipation of startup of the manufacturing process. The regulations cited for other materials herein are not applicable to the Silfab manufacturing process unless and until a listed Regulated Substance under the PSM and/or RMP regulations, in amounts above the assigned threshold quantity listed in the regulations, is present in a process. Best practice recommendations are based on TRC's engineering experience.

Table 6-1
Observations, Recommendations and Best Practices
Related to operations of the Chemicals of Interest

Regulatory Reference or Best Practice	Recommended Action	Systems Affected
Best Practice	A HAZOP study should be considered to identify control systems and safeguards and assure the safety interlocks provide the intended protections.	SiH ₄ , NH ₃ , HF, HCl, KOH
Best Practice	The facility should consider incorporating into its unloading SOPs restrictions on delivery volumes (due to the containment size) and delaying unloading due to weather events.	HCl, HF, KOH
Best Practice	The HMI at the truck unloading pad was difficult to view due to its location relative to sunlight. The facility should consider providing shade/protection for the HMI screen, relocating it, or adding a duplicate HMI screen in another location that does not receive direct sunlight. Local HMIs are currently the only way to monitor specific components of the process. Remote, central process monitoring and controls should be considered to shut down equipment during upset conditions.	HCl, HF, KOH
Best Practice	VMC panels drained to unsealed carboys in which a slow leak may not trigger a TGMS alarm and cause harmful vapors in the process area. The connections between the VMCs and carboys should be secured, but any secured connection between VMCs and carboys should allow for vapor space connectivity.	HCl, HF, KOH
Best Practice	No HF, HCl, silane, or ammonia area monitors were installed in the maintenance corridor near the DVBs. The facility should consider installing TGMS monitors in this area prior to startup.	SiH ₄ , NH ₃ , HF, HCl
Best practice	The facility should consider installing passive secondary containment for the venturi and packed bed scrubbers to prevent a potential discharge of scrubbing solution if a leak were to develop. The facility should also winterize the piping and reservoirs associated with the scrubbers to prevent potential damage during cold weather conditions.	KOH
Best practice	In its SOPs, the facility should consider updating procedures for consistency. Consider providing guidance on assessing spill volumes, provide exact procedures and when to notify the ERT for spill response and cleanup.	HCl, HF, KOH

Table 6-1
Observations, Recommendations and Best Practices
Related to operations of the Chemicals of Interest

Regulatory Reference or Best Practice	Recommended Action	Systems Affected
Best practice	It is recommended to confirm with vendors weather limitations such as unloading during rain, lightning, and extreme weather events such as wintry precipitation and tropical weather. Also confirm suitability during extreme weather situations such as summer maximum temperatures, and winter minimum temperatures in relation to outside storage in vendor provided tube trailers and isotainers.	HF, HCl, KOH, SiH ₄ , NH ₃
Best Practice	The facility should consider modifying the tank systems to allow for each tank to be completely emptied to the extent practicable for future inspections and maintenance activities. Any future tank installations should consider use of slope bottom or other designs to allow for the tanks to be completely drained. The facility should also consider providing a method for safely offloading material from the tanks to a tanker truck while controlling emissions (e.g., vapor balance), if needed.	HF, HCl
Best Practice	Develop an exhaust ventilation option for the HF and HCl storage room for mitigating vapors from the room in the case of an accidental release (e.g., scrubbing room air).	HF, HCl

Table 6-2 below summarizes observations and recommendations from preceding subsections that had not been completed because either commissioning had not started or vendor turnover of process equipment had not occurred.

Table 6-2
Observations, Recommendations and Best Practices
Related to the Commissioning of Future Operations of the Chemicals of Interest

Regulatory Reference or Best Practice	Recommended Action	Systems Affected
40 CFR 68.65 29 CFR 1910.119 (f)	For pipe leaving production going to the WWTS and to the control device/abatement systems, supporting work instructions existed for startup, shutdown and upset conditions. These instructions should be reviewed with each OEM and updated for operational parameters and operational limitations to provide stepwise instructions for normal startup, shutdown, and upset conditions.	WWTS, Abatement Systems
Best Practice	Silane will be fed to the furnace tubes during the reaction step at pressures from ~45-85 psig according to the SOP; however, design documentation indicated the maximum pressure will be 60 psig. The hot tool SOPs should be reviewed for accuracy against existing hot tool design documentation.	SiH ₄
40 CFR 68.77 29 CFR 1910.119 (i)	The plasma scrubbers were provided with interconnectivity in pairs (Scrubbers 1 & 2, 3 & 4, 5 & 6) by 3-way valves and piping for maintenance purposes. Interconnectivity and functionality of the 3-way valves should be reviewed and flow directions confirmed prior to introducing silane to the process to confirm correct flow direction.	SiH ₄

Table 6-2
Observations, Recommendations and Best Practices
Related to the Commissioning of Future Operations of the Chemicals of Interest

Regulatory Reference or Best Practice	Recommended Action	Systems Affected
40 CFR 68.77 40 CFR Subpart D 68.65 (d)(2) 29 CFR 1910.119 (i) 29 CFR 1910.119 (d)(3)(ii)	The oxidizer and scrubbers were provided with emergency backup power from a generator onsite should there be a power outage. Continuous operation of the abatement equipment would be critical for the entire wet and hot tool manufacturing processes; a thorough assessment of interlocking functionality should be conducted prior to startup.	HF, HCl, KOH, SiH ₄ , NH ₃
40 CFR 68.71(a)&(c) 29 CFR 1910.119 (g)	Operator training for the WWTS, air pollution abatement operations, and processes that utilize HF, HCl, silane, and ammonia had been partially completed. The facility should ensure detailed site-specific training to personnel with responsibility for these areas has been documented.	HCl, SiH ₄ , NH ₃ , WWTS, Abatement Systems
40 CFR 68.73(f)(2) 29 CFR 1910.119(j)(6)(ii)	The facility should finalize installation and verify functionality of planned leak detection, alarms, and interlocks throughout the process.	HCl, SiH ₄ , NH ₃ , WWTS, Abatement Systems

Section 7

Leak Prevention and Response – Maintenance Program

7.1 Maintenance Program Leak Evaluation

The existing facility maintenance program was reviewed for the following items:

- Scheduled and preventative maintenance inspections and procedures to prevent leaks and maintain system integrity
- Process to make immediate repairs if integrity issues are identified

Silfab had developed an extensive maintenance and work order system for the process train using an eMaintenance (eMaint) software package. eMaint is a computerized maintenance management system (CMMS) database for:

- Maintenance personnel to manage scheduled preventive maintenance (PM) tasks or scheduled work orders,
- Listing and managing spare parts inventory and,
- Operations or maintenance personnel to prepare work notifications and work orders for immediate repairs of process equipment.

Silfab's maintenance program was reviewed in the following manner:

- Maintenance database tables were exported to determine the maintenance scheduled work orders (commonly referred to as PMs) as well as the spare parts inventory.
- PMs were reviewed against the same codes and standards utilized in the design evaluation.
- PM SOPs authored by Silfab were reviewed for efficacy in preventing leaks and spills.
- Equipment manuals were reviewed for maintenance SOPs, drawings, process data, recommended spare parts, and PM requirements for cleaning, inspections, and calibrations.

7.2 PM Database

eMaint maintains critical equipment data, including equipment names, serial numbers, installation dates, specified individual components, PMs, links to associated PM SOP files, and scheduled and requested work orders. Implementation and maintenance of this program was an ongoing work in progress. An export of the database tables was provided by Silfab on June 1, 2026, and July 14, 2026, for evaluation.

Spare parts export files were received by TRC on June 3, 2026, and July 14, 2026. These files were reviewed to assess Silfab's ability to procure and maintain an inventory of parts to repair and maintain the process equipment.

7.3 PM SOP Review

The facility-wide eMaint database export file included nearly 200 PM SOPs, more than 1,300 asset-related scheduled work orders, more than 2,000 assets and more than 2,300 in-database procedures. To focus the evaluation on the five Chemicals of Interest, TRC ran various queries to identify process equipment, instrumentation, and spare parts related to the storage, transfer and use of the Chemicals of Interest.

Due to similarities between maintenance management of equipment for the five Chemicals of Interest, TRC's maintenance evaluation is separated into the following groupings:

- Wet, bulk processes (HF, HCl, KOH)
- Wet tools
- Gases (silane and ammonia)
- Hot tools
- Scrubbers and Oxidizer

7.3.1 Wet Bulk Processes (HF, HCl, KOH)

Unloading and Bulk Storage

Scheduled work orders for this area included daily, weekly, monthly, and annual inspections. The PM frequency and tasks appeared to be appropriate for the equipment currently in eMaint. Annual inspections and testing (e.g., Poly Tank Inspections or secondary containment/foundation structural inspections) contained adequate detail as to how the inspections and testing would be completed and who was qualified to perform these tasks. It is recommended that Silfab develop a plan for what to do in case of "failed" inspection results.

Based on the database export files reviewed, PMs were in the process of being developed and entered into the database for the calibration of various instruments in this area (e.g., flow, tank level, and pressure). Based on a review of the spare parts database export file, a partial spare parts inventory had been prepared for equipment in this area.

Distribution

Scheduled work orders for this area included daily, weekly, monthly, and annual inspections. In general, the PM frequency and tasks appeared to be appropriate for the equipment currently in the eMaint database.

The eMaint database included PM tasks for HF, HCl, and KOH VMBs in the clean rooms. In addition, monthly visual inspections should be conducted for instrumentation in this area (e.g., flow, pressure, and temperature).

Wet Tools

PMs for the wet tools were classified in the eMaint database by the wet tool names (i.e., Batch Clean, Batch Etch, Batch Texture, InEtch Side, and InPolyside). Each tool had a significant number of entries for weekly, monthly, and annual monitoring inspections and cleanings. PM procedures were primarily developed from the original equipment manufacturer (OEM) manuals; these procedures were reviewed against the OEM manuals as part of this evaluation.

Based on the database export file, Silfab had initiated the input of the PMs for the calibration of various instruments in the wet tools area (e.g., flow, level, mass and pressure). Based on the July 14, 2026 spare parts database export file, an extensive list of spare parts for the Batch Etch, InEtch Side and InPolyside wet tools was included.

7.3.2 Gas Processes (Silane and Ammonia)

Trailer Storage

The silane and anhydrous ammonia trailers were provided by the suppliers who are responsible for the testing and inspection of these vessels. Confirmation of documentation that the trailer had been tested and inspected was required to be reviewed as part of the material receiving checklist. Procedures stated that if testing and inspection documentation was found to be inadequate, the trailer would not be allowed to disconnect from the tractor and the trailer would be rejected.

Once a tractor is disconnected from the trailer, the trailer becomes an on-site storage unit for the material and becomes part of the overall PSM and RMP regulated process. At the time of this evaluation neither of these trailers were connected to the rest of the process. Daily checks for leaks were included in the daily checklists.

The trailer storage/unloading areas had several instruments associated with release and fire detection. Based on the database export files reviewed, PMs were in the process of being entered into the database for the calibration of various instruments in this area (e.g., flow, tank level, and pressure). The supporting procedures for the specific sequence steps of work were still under development at the time of this evaluation. Based on the review of the spare parts database export file, a partial spare parts inventory had been prepared for equipment in this area .

Distribution

Scheduled work orders for this area included daily, weekly, monthly, and annual inspections. The PM frequency and tasks appeared to be appropriate for the equipment currently in the eMaint database. The following inspection protocols were updated over the course of the evaluation to provide detail as to how the inspections would be completed and who was qualified to perform the inspections:

- Annual mechanical integrity inspections (e.g., manifolds, valve boxes, ventilation flow, and relief devices)
- Weekly inspections of ammonia piping and welds for corrosion, cracks, or discoloration
- Monthly inspection of ammonia instrumentation (pressure gauges and transmitters) for accuracy

Based on the June 1, 2026 database export file, PMs existed for the silane DVB and the calibration of instruments involved in silane and ammonia distribution (e.g., pressure gauges). Based on the June 3, 2026 spare parts database export file, a spare parts inventory did not include parts for the silane and ammonia DVBs and VMBs.

Hot Tools

PMs for the hot tools were classified in the eMaint database by the hot tool names (i.e., PECVD and LPCVD). Each tool had a significant number of entries for weekly, monthly, and annual monitoring inspections and cleanings. PM procedures were developed from the original equipment manufacturer (OEM) manuals; these procedures were reviewed against the OEM manuals as part of this evaluation.

Based on the June 1, 2026 database export file, PMs were input for various instruments in the hot tools area (e.g., flow and pressure), and based on the spare parts database export file, a spare parts inventory was available for the hot tools.

TGMS

Based on the June 1, 2026 database export file, the TGMS was maintained by a third-party contractor and included PMs for a 3-month bump test and an annual calibration test. It is recommended to develop internal capabilities for performing tests and calibrations on the TGMS versus relying on a third party contractor for maintenance of these systems. Silfab should consider more frequent testing/calibration of the units to verify proper operation.

Wastewater Treatment System (WWTS) and Control Devices

Scheduled work orders for the piping to the WWTS area were included in daily, weekly, monthly, and annual inspections. In general, the PM frequency and tasks appeared to be appropriate for the equipment currently in the eMaint database.

7.4 Recommendations and Observations

Table 7-1 below summarizes observations and recommendations from preceding subsections related to processes of the Chemicals of Interest. TRC has included a column in this table for regulatory references and best practices. The inclusion of regulatory references does not necessarily indicate non-compliance. The PSM and RMP rules referenced are only applicable at this time for the storage of Silane and Anhydrous Ammonia. The regulatory references below for the other operations are provided for information purposes in anticipation of startup of the manufacturing process. The regulations cited for other materials herein are not applicable to the Silfab manufacturing process unless and until a listed Regulated Substance under the PSM and/or RMP regulations in amounts above the assigned threshold quantity listed in the regulations is present in a process. Best practice recommendations are based on TRC's engineering experience.

Table 7-1
Recommendations Table – Maintenance Program

Regulatory Reference or Best Practice	Recommended Action	Systems Affected
Best Practice	PMs for mechanical integrity inspections and testing need to be updated for the HCl, KOH, and HF storage tanks. An equipment replacement plan should be developed and implemented for equipment that fails and cannot be repaired.	HCl, SiH ₄ , NH ₃ , KOH, HF
Best Practice	It is recommended that Silfab develop a plan for what to do in case of "failed" inspection results.	HF, HCl, KOH
Best Practice	It is recommended to develop internal capabilities for performing tests and calibrations on the TGMS versus relying on a third party contractor every 3 months. The facility should consider increasing the frequency of bump tests and calibrations to verify proper operation of the TGMS.	SiH ₄ , NH ₃ , HCl, HF
Best Practice	Continue development and implementation of maintenance procedures and critical spare parts inventories.	HCl, SiH ₄ , NH ₃ , KOH, HF

Section 8

Leak Response Program

TRC evaluated the leak response procedures and supporting documentation provided by Silfab. Documents reviewed by TRC are listed in Appendix F.

TRC prepared a leak response evaluation protocol giving consideration to applicable OSHA and EPA regulations, additional state regulations for applicable safety and environmental regulations, and frequently cited industry standards. The response procedures and supporting documentation were compared to this evaluation protocol. TRC then conducted on-site observation and interviews with Silfab personnel to validate leak response plan content and associated procedures and, where identified, develop findings and observations. The following sections describe the document evaluation process, the on-site evaluation and interviews, and the findings and observations.

8.1 Document Evaluation

The key documents reviewed for the leak response program at the facility were the Facility Emergency Action Plan (FEAP) and its appendices and attachments. The facility generally used the FEAP to meet OSHA 29 CFR 1910.38 Emergency Action Plan, OSHA 29 CFR 1910.120(q) HAZWOPER, OSHA 29 CFR 1910.119(n) Process Safety Management Emergency Response, and EPA 40 CFR 68 Risk Management Planning Emergency Response requirements. The FEAP included a regulatory cross-reference matrix.

The FEAP applied to employees, contractors and visitors at the facility, describing incidents and their classification; procedures for response, evacuations and shelter-in-place scenarios; and description of emergency response management, responsibilities, notifications, procedures for response, and key contacts. The FEAP described the organization of the Emergency Response Team (ERT) personnel and use of Incident Command System (ICS). The Plan described the hazardous materials onsite, responsibilities, procedures, and ERT team requirements. The FEAP also described the general training for employees, contractors, and visitors.

The facility elected to train its employees to First Responder Awareness Level and its ERT members to First Responder Operations Level (i.e., contain a release). A subset of the ERT had been trained to the HAZMAT Technician level and could attempt to stop releases and begin clean-up activities. Based on the FEAP, ERT personnel also were authorized to perform first aid/medical response and support evacuations.

The facility elected to have trained personnel use fire extinguishers for incipient-state fires that may occur. The facility had also elected to have ERT personnel perform first aid/medical response, hazardous materials response, and in concert with operations management and human resources, serve as evacuation wardens and sweep personnel.

Supporting the FEAP were the following key plans and documentation:

- Slug Discharge Plan, which applied when chemicals were discharged into the sewer system and the facility was required to notify the POTW operator;
- Stormwater Pollution Prevention Plan (SWPPP), referenced as “Spill Prevention and Response Plan”, included procedures to respond to liquid spills to prevent stormwater impact;
- Risk Management Plan (RMP), which applied to the Regulated Substances – anhydrous ammonia, silane, and hydrochloric acid with a concentration of 37% which will be present at the facility above the threshold quantity thus triggering the requirement for an RMP;
- Crisis Plan for managing communication;
- First Aid Procedure and supporting Chemical First Aid Protocols;
- Decontamination Procedure;
- Response Procedures on a chemical-by-chemical basis;
- Area Action Plans for the various departments onsite (which incorporated sweep instructions and shelter-in-place HVAC shutdown responsibilities);
- Training Documents for ERT members; and
- Drills and Exercise Documentation.

8.2 On-site Evaluation

TRC reviewed the FEAP with the Health and Safety Manager for additional information on June 3, 2026, followed by a facility tour of the assembly area, clean room etch areas, gas sheds, and chemical/wastewater treatment buildings. TRC conducted interviews and detailed area tours for response equipment and for exit access to the assembly points on June 4, 2026. During the site visit, the Silfab personnel in the following key response roles were interviewed:

- Health and Safety Manager – the program owner for emergency response and the primary Incident Commander
- Manufacturing Engineer – subject matter expert (SME) for the etch area equipment
- Chemical Area Technician and Emergency Responder – ERT members from the chemical area may serve as chemical leak responders, medical responders, and evacuation wardens
- Chemical Area Manager – SME for Buildings B and C and the gas sheds and alternate Incident Commander
- Facilities Manager – SME for facilities components supporting the response team and preparer of the facility’s RMP
- Human Resources Manager – evacuation warden / sweep of office areas during evacuations

- Plant Manager – leadership support for Health and Safety and Emergency Response programs

Based on the documentation provided by Silfab, TRC evaluated exit routes, chemical storage and containment, spill kits, and decontamination equipment. During the site visit for this task, TRC observed a propane incident that was upgraded to an evacuation, and where applicable, the evacuation was referenced in the interviews to form recommendations and observations.

8.2.1 Evacuations

The FEAP described triggers for leak response evacuations, including high-level TGMS alarms, fire alarms, and announcements using the Intercom System. At the time of the site visit, the intercom system was not fully operational. The facility had implemented a MS Teams® management distribution to allow managers to communicate non-alarm evacuation instructions. That communication method was included in the FEAP and its Area Action Plans.

8.2.2 Response Capability

The FEAP and chemical-specific response procedures described the ERT capabilities, equipment, and supplies at a high level. Detailed descriptions of the equipment, supplies and procedures had also been developed, such as documented stocks of neutralizer for acid spills.

The ERT consisted of personnel from chemical operations, maintenance, and health & safety, with additional management and operations members. Post-response waste management was managed by the environmental engineer, as noted in the FEAP.

8.2.3 Decontamination

The FEAP and associated Decontamination Procedure described that ERT members would utilize standard decontamination procedures at the entry/exit point to a chemical spill area. The facility team also indicated that tank containment rooms in the Chemical Storage building may also be used for decontamination staging.

8.2.4 Facilities

The ERT team utilized radios and mobile phones for communication. The storage lockers in the wastewater treatment area appeared to be adequately stocked with PPE, decontamination gear, and spill absorbents. Portable monitors that measure ammonia, HF, HCl, and other constituents were available on-site for use by the ERT, and the facility had calibration gases available for the instruments. The facility had designated an “emergency operations center”, and equipment needed for a center was stored in portable containers that could be readily moved.

8.3 Findings/Observations

The findings identified during the leak response program evaluation based on applicable regulation and frequently cited industry standards are provided in the following table.

Table 8-1
Findings Table – Leak Response

Topic/Medium	Citation	Finding Text
Emergency Action Plan	29 CFR 1910.37(e); 1910.38(d); 1910.165 (d)(1)	The employee alarm system, as described in the FEAP and HAZWOPER plans, consisted of alarms from the Toxic Gas Monitoring System, fire/smoke alarm system, and an intercom system. During the site visit, the intercom system had not yet been fully installed. As a result, communications during the propane evacuation event on 6/3/26 relied on MS Teams® messaging to the management staff and verbal instructions as opposed to the evacuation announcements described in the EAP.
Exit Routes	29 CFR 1910.37(b)	In the portion of the Etching Area that exits between Buildings B and C, no "clearly visible" exit sign had been installed.
Process Safety Management/Risk Management Program	29 CFR 1910.119 (f) (4); 1010.119 (h)(2)(iv); 40 CFR 68.87(b)(4); 68.69(d)	The facility's PSM and RMP programs did not clearly define security measures to prevent outside or employee entry to the PSM process boundary.

Observations related to the regulations and standards that did not rise to the level of a finding are presented in the following table:

Table 8-2
Observations Table – Leak Response

Topic/ Medium	Observation Text
Emergency Action Plan	The following was noted in the facility's EAP: - Unknown Spills - guidance for operators to involve ERT for characterization when encountering an unknown spill was not included. The facility should consider how operators and ERT members will address unknown spills or mixtures (e.g., acids versus bases)
Exit Routes	The graphite boat furnace room had a single emergency exit that led back into the deposition area of the cleanroom. One roll-down door was present that led into the panel assembly area. No second pedestrian exit door had been installed at the time of the evaluation.

Section 9

Emergency Response Procedures

TRC reviewed the emergency response procedures and supporting documentation provided by Silfab, including emergency response training, coordination with local responders, emergency drills and exercises, and notification procedures.

TRC prepared an emergency response evaluation protocol based on applicable OSHA and EPA regulations, additional state regulations for applicable safety and environmental regulations, and frequently cited industry standards. The response procedures and supporting documentation were compared to this evaluation protocol. TRC interviewed coordinating agencies and contractors regarding the Silfab emergency response program. TRC then conducted on-site observation and interviews with Silfab personnel to validate emergency response plan content and associated procedures and, where identified, develop findings and observations. The following sections describe the document evaluation process, coordinating agency and contractor interviews, the on-site evaluation and interviews, and the findings and observations.

Based on the documentation provided by Silfab, TRC evaluated exit routes, chemical storage and containment, spill kits, and response and decontamination equipment. During the site visit for this task, TRC observed an incident that included an evacuation. Where applicable, the evacuation was considered when forming recommendations and observations.

A copy of the emergency response documentation provided by the facility is presented in Appendix F.

9.1 Emergency Response Program Applicability

Silfab is subject to OSHA 29 CFR 1910.38 “Emergency Action Plan” requirements, based on the number of employees (i.e., more than ten). Silfab is also subject to the 29 CFR 1910.39 “Fire Prevention Plan” requirements, based on providing portable fire extinguishers and training employees to use them. Silfab is also subject to 29 CFR 1910.119 “Process Safety Management” requirements. Because the facility has an emergency response team (ERT) that could conduct at least initial emergency response to releases, or substantial threats of releases of hazardous substances, the facility is subject to the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) emergency response requirements under 29 CFR 1910.120(q).

Because Silfab handles certain RMP chemicals above the regulated threshold, the facility is subject to emergency response requirements of 40 CFR 68.90 – 68.96. The facility is a “responding stationary source” under 40 CFR 68.90(a) because the ERT will respond to accidental releases of regulated substances. As a result, the facility is required to perform documented annual emergency response coordination activities under 40 CFR 68.93; prepare an emergency response plan, develop procedures

for use, test and maintain emergency response equipment, conduct training, and develop procedures to review and update the plan under 40 CFR 68.95; and conduct annual notification exercises each calendar year beginning by December 19, 2024, with field exercises due by March 15, 2027 and tabletop exercises by December 21, 2026¹. The regulations allow that a written plan that complies with other Federal contingency plan regulations or that is consistent with the approach in the National Response Team's Integrated Contingency Plan Guidance ("One Plan") when combined with elements described 40 CFR 68.95 (a) and (c) is considered satisfactory.

The key documents reviewed for the emergency response program at the facility were the Facility Emergency Action Plan (FEAP) and its appendices and attachments. The facility generally used the FEAP to meet OSHA 29 CFR 1910.38 Emergency Action Plan, OSHA 29 CFR 1910.120(q) HAZWOPER, OSHA 29 CFR 1910.119(n) Process Safety Management Emergency Response, and EPA 40 CFR 68 Risk Management Planning Emergency Response requirements. The FEAP included a regulatory cross-reference matrix.

TRC's review of the FEAP is outlined in Section 8.1.

9.2 Emergency Response Training

Employees must receive HAZWOPER training appropriate to their role, ranging from 24-hour to 40-hour courses for site workers, plus annual refresher training. The facility elected to train its facilities (including chemicals) personnel, maintenance personnel, and select employees from other departments to First Responder Awareness Level. The facility identified a subset of the awareness group as its ERT members and trained them to First Responder Operations Level (i.e., contain a release). A second subset of the ERT had been trained to the HAZMAT Technician level and could attempt to stop releases and begin clean-up activities.

Some of the ERT members were trained to provide medical emergency response (i.e., first aid/cardiopulmonary resuscitation (CPR)/automatic external defibrillator (AED)).

The facility provided documentation regarding the training for the Awareness and Operations levels, beginning in November 2024 and continuing through January 2026. The documentation included training provided using a combination of instructor-led and online content. Review of training records for a sample of two to five employees from each group (i.e., ERT First Responder Operations members, ERT HAZMAT Technicians, and non-ERT operations employees) did not identify issues with emergency response training.

The FEAP described the training for the ERT members and ICS leaders. The OSHA EAP requirements for training employees, contractors, and visitors had been included in the FEAP.

¹ TRC notes that portions of the RMP Rule may be reconsidered and that the emergency response exercise deadlines may change.

9.3 Coordination with Local Responders

Silfab had documentation to demonstrate coordination with key local responders. To further evaluate that coordination, questionnaire-based phone interviews were conducted with the agencies, hospital emergency response coordinator, school district, response contractors, and certain chemical suppliers. The questionnaire was constructed of general questions applicable to all, with specific questions for the role that the agency, school district, response contractor or chemical supplier fulfills in emergency response. The general questions included:

- How has the Facility coordinated with your agency/firm?
- How often has that coordination occurred?
- What regulatory programs were being met in that coordination?
- Has the Facility conducted drills and exercises with your agency/firm?
- Do you have after-action reports from responses and/or drills?
- Does the Facility have notification procedures with your agency/firm?
- How does your agency provide feedback for the Facility's use in their after-action reports?
- Does your agency have previous experience with the chemicals present at the Facility? Do other facilities in the response area use these chemicals?

A summary of the results from this questionnaire is presented below. Findings and observations are included and then re-presented in the tables of Section 9.7.

- Flint Hill Fire Department (FHFD) / Chief Todd Wisner: Coordination between the FHFD and Silfab has been frequent since March, with discussions covering the multiple regulatory programs that apply to Silfab. Silfab has hosted HAZWOPER training, drills and exercises; FHFD feedback on those drills and exercises has been verbal. This volunteer department continues to obtain Hazardous Materials Technician-level training for its members. When a Hazmat call comes into 911, York County Emergency Management Agency (EMA) is also dispatched. The facility had addressed a traffic recommendation early in the coordination process.
- York County EMA / Director Chuck Haynes: Coordination has been frequent because Silfab is a new operation that brings new chemistries. A tabletop exercise and drills have been conducted with Silfab, EMA, and FHFD. Feedback thus far has been verbal but EMA may choose to use written feedback on a case-by-case basis. York County EMA has experience with the chemicals of interest in the agreement, except silane. In response, EMA performed direct training with the chemical supplier for silane. EMA was not aware of other silane users in the EMA's response area. York County EMA also coordinates with City of Rock Hill and City of Charlotte. EMA has no Memoranda of Understanding (MOU) with any private industry with the exception of nearby nuclear facilities under the direct regulatory purview of federal agencies. If 911 dispatch gets a HazMat call or if FHFD or police arrive and request support, the combined EMA / York County Fire Service

partnership is activated. The plans and protocols are EMA-managed. Either method activates the resources. EMA has suggested a central dispatch number to Silfab as identified in the tabletop. The facility has already considered security and access recommendations from the EMA. Silfab may benefit from hardening the perimeter to prevent unauthorized access. Piedmont and Atrium hospitals are included in the York County ERP; these contract EMS transporters for those hospitals should also be included in coordination. EMA's approach is to use a specialty/trained response team and personnel to respond to hazardous materials calls for service that augments the hazardous materials capabilities and personnel of each individual agency responding throughout the county. Under this method, every department possesses basic training to respond to hazardous materials situations, with some departments choosing to provide an elevated level of training and response. Meanwhile, the specialty team serves to bolster the initial response with additional equipment and personnel as incident conditions warrant.

- Piedmont Hospital: TRC interviewed the Emergency Response Coordinator for the hospital. There has been no direct coordination to date with Silfab, but Piedmont has experience with treating exposures to the chemicals of interest except silane. Piedmont recommends that injuries go to the Rock Hill trauma center instead of the Gold Hill emergency department based on resources. The EMA communicates potential exposures to the hospital. Coordination with the EMA is well-practiced; the EMA has monthly meetings and has conducted many exercises and drills. She noted that emergency medical service (i.e., ambulance service and referred to as EMS) in York County is provided by two vendors; one EMS is owned by Piedmont and the other (in Fort Mill) is owned by Atrium. No county EMS exists. Dispatch for EMS is co-located with county 911 and uses the closest EMS to the caller location. Silfab has since coordinated with both EMS providers as noted in the FEAP.
- SCDES Bureau of Air Quality (BAQ) / Section Manager Zachary Carfley: Since 2024, SC DES has primarily coordinated with Matt Korzelius of Silfab, including an initial RMP inspection with no findings or observations. Drills and exercises should be coordinated with the closest DES Regional Office (Lancaster). Notifications of incidents should include the DES Regional Office or the state DES Emergency Response hotline in the Plans, as opposed to notifying BAQ first. BAQ would likely visit the facility after emergency response has concluded. He noted that BAQ RMP Coordinator is notified when the National Response Center or SC DES ER hotline is contacted. He noted that DES has experience with the chemicals of interest but that experience is very limited for silane. Silfab has included the DES hotline and the Regional Office in the contacts list for the FEAP.
- Fort Mill School District (FMSD) / Chief Communication Director Joe Burke; Dr. Latoya Dixon, Assistant Superintendent for Student Services and Administration, and Grey Young, Superintendent: Coordination with Silfab was limited to brief conversations prior to March 2026. Coordination in terms of notification then increased, for about a month. Since April, the communications have changed from texts from the plant manager to emails from other staff members. Emails may not be responded to by FMSD employees during non-business hours. The

overall message is that FMSD needs to be kept informed, as parents are calling the schools and the district offices after each emergency vehicle goes to the Facility and after each Facility alarm.

- The School District coordinated the May 2026 tabletop exercise with Silfab, using EMA to moderate. EMA captured the after-action items from the tabletop. In that exercise, the school district provided content from their response plan and collected copies at the conclusion of the event. Sharing Silfab response procedures will increase FMSD comfort.
- One of the after-action items from the May exercise was to standardize the portal or method for immediate communication/notification to the FMSD Safety and Emergency Services Coordinator, i.e., text is preferred over email. FMSD prefers that Silfab overshare, especially to assist communication with parents that ask the District for more information when emergency assistance comes to the Facility, even when the incident is not an actual emergency. They asked that Silfab identify the frequency of notifications and follow through on the exercises/drills/notifications. They have observed that notifications have decreased in the last few months; follow-through on notifications may assist in building relationships.
- Per FMSD, other industrial facilities have chemical response planning within the school district; however, other industrial facilities are not in close proximity to a school and do not have similar storage quantities. FMSD noted that the new schools and new after-school sports events on fields immediately adjacent to the Silfab leasehold will lend themselves to additional coordination. FMSD also noted that they may also allow third parties to use the property for events such as sport camps.
- Carolina Emergency Response Team (CERT): TRC interviewed a representative of CERT. CERT has supported recent response, using a purchase order as opposed to an established contract. They have experience with the chemicals of interest except silane. They have specific personnel for such chemical hazards, and those experts would coordinate with their on-call crew, which is an initial response crew of three people available 24/7. On weekends and nights, the on-call crew may take 0.5-2 hours to respond. CERT has three fully equipped spill response trucks; each truck can immediately handle up to 500 gallons. Additional supplies are readily available locally. They did not participate in the ICS-structured response in March. They communicated and worked with the environmental engineer after the event.
- HazMat NC: TRC interviewed a representative of HazMat NC. HazMat NC supported Silfab by transporting water from the retention pond during the March 2026 event. They have 15-20 team members and access to 60 responders. They also team with other firms, such as CERT, to support responses. HazMat NC was acquired by Miller Environmental Group at the end of March 2026. They have capabilities for HCl, HF, and KOH but not for ammonia and silane. No drill or exercise participation to date has been conducted with Silfab. They have facilitated drills, exercises, and tabletops for other clients.

- TRC also contacted HEPACO as a response contractor listed in the FEAP. At the time of this report, the contact cited security approval concerns prior to discussing their client with TRC.
- REC Silicon (silane supplier): TRC interviewed a representative of REC. REC will provide full assistance for silane incidents that occur on the gas pad and is a direct fault of REC Silicon company modules. They have an assistance flow chart outlining their support and have highly trained teams that would respond to a silane incident at the facility. They have the equipment to handle silane incidents. They give customers the option to allow REC Silicon to take control of the ICS or to serve as consultants. They routinely participate in drills and exercises with customers and with local authorities. They routinely provide after-action feedback on incidents and drills/exercises, including written feedback.
- Linde (ammonia/silane/gases supplier): TRC interviewed a representative of Linde. Linde has supported Silfab in the past and has previously served on the Linde ERT. They noted that Linde operates about 15-20 ERTs around the US; the closest one to Fort Mill is in Research Triangle Park, NC. Each ERT operates with a team lead and two technicians who are trained to remediate the situation at hand. Teams have fully stocked trucks/trailers (e.g., SCBAs and other response equipment).

They also discussed possible failure scenarios. He was not aware of incidents happening with the entire tube trailer but said that Linde ERTs train for this scenario. It is unlikely that the whole trailer would fail at once; it is more likely that an issue could happen with a single tube. In this case, their ERT would isolate the tube and flare off the tube, likely with involvement from the local fire department. Linde does not typically do drills/ exercises at customer sites but may participate in regional exercises. Their ER phone line averages about 150 calls/year; most of the issues can be stabilized over the phone with no on-site response.

Regarding ICS, Linde can operate in the capacity needed at the time. They can take the lead as the IC, which happens most frequently during a gas incident due to their expertise. Linde's ERTs are also comfortable working under the FD or a facility IC. Use of Linde's ERTs is typically covered in customer contracts.

- Transene (hydrofluoric acid/hydrochloric acid supplier): TRC interviewed a representative of Transene. Transene does not provide emergency response and can share the information presented in the SDS. Transene asked to be notified if a leak occurs from an isotainer.

9.4 Drills and Exercises

Based on its regulatory status, Silfab is required to perform drills and exercises under state-adopted fire code and Risk Management Plan regulations. While other regulations may not specifically require drills, the following regulations require elements that are tested through the process of drills and exercises:

- Emergency Action Plan (29 CFR 1910.38)

- Fire Protection (29 CFR 1910.157 – 165)
- Risk Management Program (40 CFR 68.90 – 96)
- Process Safety Management (29 CFR 1910.119)

Drills and exercises were documented for November 2024, May 2026, and June 2026. Silfab had conducted drills and exercises for emergency response using internal staff and with outside agencies.

For RMP-specific requirements, the drills and exercises met the annual notification exercise requirement, using the November 2024 exercise and May 2026 exercise. The facility is planning a tabletop exercise with RMP-regulated chemical scenario to meet the December 21, 2026 RMP tabletop exercise deadline.

The scheduled frequency and scope of the drills and exercises had been tied to regulatory drivers like RMP and to management commitments in a matrix attachment. Observations are presented in Section 9.7 below.

9.5 Notification Procedures

Silfab stated in its emergency response plan documents that it uses Incident Command System (ICS) model that is led by on-site Incident Command personnel. The FEAP “Incident Level” model and associated procedures for chemical spills and releases describe that, for “large” chemical/gas releases (55 gallons/200 pounds/200 cubic feet), Incident Command may be shared (“unified command”) or transferred to the local / county / state emergency response lead on-site. The FEAP included notification steps in each of the emergency response procedures, starting with access to 911 services and onsite management, neighboring facilities (Fort Mill School District, Ross Distribution, and Motion Industries), responding agencies, and spill response contractors. Notification to the silane and ammonia suppliers for subject matter expertise was included in the procedure.

Silfab also had two requirements for local notification that are specific to the jurisdiction. First, the County EMA had a requirement for notification of chemical/gas releases as per York County Ordinance 36.12(B). The reporting trigger for the York County ordinance was stated in the FEAP Non-Emergency definitions in Section 4.

Second, for chemicals regulated under the Clean Air Act, EPCRA, or CERCLA, a 1-gallon release or leak from piping or tank system threshold was included as Condition 7 of the SC Department of Environmental Services (SCDES) Compliance Agreement dated March 16, 2026. That condition to notify SCDES was in effect for one year after the execution date of the Compliance Agreement. The 1-gallon release or leak trigger had not been included in the FEAP at the time of the site visit but was widely cited by facility personnel during interviews.

Combining the reviews of the FEAP, site visit observations and interviews, and the interviews with the local responders noted in Section 9.3 above identified a limited number of findings and observations that are presented in Section 9.7 below.

9.6 Response Team/Capability

The FEAP and the HAZWOPER Plans described the ERT capabilities, equipment, and supplies at a high level. Detailed descriptions of the equipment, supplies and procedures had also been developed, such as documented stocks of neutralizer for acid spills.

The ERT consisted of personnel from chemical operations/facilities, maintenance, and health & safety, with additional management and operations members. The facility had designated and trained approximately 50 ERT members using the HotZone USA 24-hour Hazardous Material Technician with incident command system (ICS) curriculum (i.e., “awareness” level). Fifteen (15) more members were trained to the First Responder operations level. Finally, another fifteen members were trained to 40-hour Hazardous Material Technician level.

The health & safety manager indicated that each shift will include a minimum of six (6) ERT members (two sets of two ERT members for hot zone entry, one for decon/health & safety, and one incident commander). At the time of the site visit, the facility operated 24 hours per day, five days per week, and the number of ERT members appeared to meet or exceed the minimum staffing plan.

Entry exercise documentation from March 2026 indicated that at least 15 members of the ERT Hazardous Materials Technician-trained personnel had practiced response in full gear. The facility generally had the training, equipment, and exercise practice to handle a “small” release as defined in the FEAP.

Post-response waste management was to be managed by the environmental engineer, as noted in the FEAP.

Review of the evacuation systems, decontamination, and response equipment/facilities was included in Section 8.2.

9.7 Findings/Observations

The findings identified during the emergency response procedures review based on applicable regulation and frequently cited industry standards are provided in the following table. Several of these findings are duplicates to the findings listed in Section 8.7 and are noted as such.

Table 9-1
Findings Table – Emergency Response

Topic/Medium	Citation	Finding Text
Emergency Action Plan	29 CFR 1910.37(e); 1910.38(d)	The employee alarm system, as described in the FEAP and HAZWOPER plans, consisted of alarms from the Toxic Gas Monitoring System, fire/smoke alarm system, and an intercom system. During the site visit, the intercom system had not yet been fully installed. As result, communications during the propane evacuation event on 6/3/26 relied on MS Teams® messaging to the management staff and verbal instructions as opposed to the evacuation announcements described in the EAP. (DUPLICATE)
Exit Routes	29 CFR 1910.37(b)	In the portion of the Etching Area that exits between Buildings B and C, no "clearly visible" exit sign had been installed. (DUPLICATE)
Process Safety Management/Risk Management Program	29 CFR 1910.119 (f) (4):1010.119 (h)(2)(iv) 40 CFR 68.87(b)(4); 68.69(d)	The facility's PSM and RMP programs did not clearly define security measures to prevent outside or employee entry to the PSM process boundary. (DUPLICATE)
SC DES Compliance Agreement	Condition 7	The Compliance Agreement sets a notification threshold of one gallon until March 16, 2027, for releases of EPCRA, CERCLA, or Clean Air Act-regulated chemicals. That threshold has not been addressed in the FEAP Release Reporting procedure.

Observations related to the regulations and standards that did not rise to the level of a finding are presented in the following table. Several of these observations are duplicates to the observations listed in Section 8.7 and are noted as such.

Table 9-2
Observations Table – Emergency Response

Topic/Medium	Observation Text
Emergency Action Plan	The following were noted regarding the facility's EAP: - Unknown Spills - guidance for operators to involve ERT for characterization when encountering an unknown spill was not included. The facility should consider how operators and ERT members will address unknown spills or mixtures (e.g., acids versus bases) (DUPLICATE) - The FEAP appeared to be prepared to address the requirements of 29 CFR 1910.39 (Fire Prevention Plan). This should be clearly stated in the plan introduction, as well as stating it addresses the requirements of 29 CFR 1910.38.
Exit Routes	The graphite boat furnace room had a single emergency exit that led back into the deposition area of the cleanroom. One roll-down door was present that led into the panel assembly area. No second pedestrian exit door had been installed at the time of the evaluation. (DUPLICATE)

	Similarly, the pedestrian gate in the security fencing outside Building B had been removed and covered with fencing. Personnel evacuating from the main plant and Buildings B and C towards Assembly Area A-4 would have to re-enter the main building if the truck gate was locked.
Community Response Coordination	While the Compliance Agreement and the Emergency Management Ordinance provide notifications requirements with minimal release thresholds, the School District has requested notifications with a different, community-based focus. They reported that the facility initially agreed to report events that could be interpreted by neighbors as a reason to pick up their children from school. Social media reporting may create confusion and panic for parents, impacting the schools.

Through the commissioning process, Silfab should implement recommendations in this report and continue evaluation of their leak prevention and response methods. In addition, Silfab should provide the SCDES with confirmation that recommendations associated with the leak prevention and response methods have been completed.

Section 10

Evaluation Team Qualifications

Robert Krumm, PhD., PE (ID, TX) of WSP provided the engineering and construction document review for this project. Dr. Krumm is the Technical Director of Chemical Engineering for WSP, TRC's parent company. He earned both Bachelor of Science (BS) and Doctor of Philosophy (Ph.D.) degrees in chemical engineering from the University of Utah. Dr. Krumm has over 12 years of professional experience in both industrial and consulting engineering roles.

A.W. "Matt" Fail, III, PE (NC, SC), TRC Senior Process Engineer, provided the evaluation of operations and maintenance procedures for this project. Mr. Fail holds both BS and Master of Science (MS) degrees in chemical engineering from Clemson University and has over 25 years of professional experience in both industrial and consulting engineering roles. His areas of expertise include plant and process engineering, facility maintenance, and OSHA Process Safety Management (PSM) program development and compliance.

Mark Robinson, CHMM, PE (NC) and **Wade Narin van Court, PhD, PE (CA, WA, ME)** provided the evaluation of leak and emergency response procedures for this project. Mr. Robinson is TRC's Environmental, Health and Safety (EHS) National Service Leader for Chemical Management and Reporting. He holds a BS in Applied Biology from Georgia Tech and MS in chemical engineering from New Mexico State University. He has over 25 years of EHS experience in both consulting and industrial roles. Dr. Narin van Court, TRC Senior Engineer, earned a BS in civil engineering from the University of Washington and MS/PhD degrees in geotechnical engineering from University of California at Berkeley. His 30+ years of consulting experience include providing oil/chemical release prevention and response and emergency preparedness to a variety of government and private sector clients.

Kimberly W. Fail, PE (NC, SC) conducted response contractor and chemical supplier interviews for this project. Ms. Fail is a senior consulting engineer and project manager with TRC, who holds a BS in chemical engineering and a MS in environmental systems engineering from Clemson University. Her 25+ years of experience include both consulting and industrial EHS management roles.

Jimmy Graves, PE (SC, NC, FL) is the professional engineer and technical lead for this combined leak prevention and response evaluation. Mr. Graves is a senior consulting engineer and project manager with TRC, who holds a BS in chemical engineering from the University of Alabama. His 20+ years of professional experience encompass both EHS consulting and industrial process engineering roles involving the development and management of leak detection and repair programs and spill prevention controls and countermeasures.

Daniel Curry is the project manager for this leak prevention and response evaluation. He is a Director of Strategic Project Development in TRC's Greenville, South Carolina with nearly 40 years of environmental engineering and compliance experience in a wide variety of industries and processes. His professional experience includes 13 years of industrial site experience as an environmental engineer and manager at

fully integrated pulp and paper mills and 25 years of client management experience in process safety and compliance systems.

Appendix A

Environmental Policy



Environmental Policy – Following ISO 140001:5.2

Document ID: SIL-ESG-POL-001-H

of Pages: 1

Revision Date: January 1, 2026

Revision Level: H

Revised By: Marketing

Approved By: DCN #21-27

Printed documents are **UNCONTROLLED** unless stamped as **CONTROLLED DOCUMENT**.

Silfab Solar is committed to operating in accordance with the Environmental Policy and all legal requirements. The company commits to the continuous improvement of our environmental programs, including the documentation, implementation, and maintenance of a formal Environmental Management System by adopting the following policies and practices:

Foster environmental stewardship among employees of all levels, including those working on behalf of the company

Continually improve the environmental performance of the facility to conserve energy and water while reducing waste and minimizing our carbon footprint

Comply, and where possible go beyond, applicable federal, state, and local environmental laws and regulations, and other requirements to which Silfab Solar subscribes.

Adopt policies and practices that reduce the consumption of resources through waste management strategies that promote waste minimization re-use, recovery, and recycling, whenever feasible.

Through training and awareness, Silfab Solar, employees are aware of environmental impacts of their work activities and how to minimize those impacts.

Committing a program of continuous improvement by reviewing our Environmental Management System through internal audits and related objectives and targets, policy and practices.

Paolo Maccario
President and CEO

Treff MacDonald
Chief Operating Officer

Appendix B

Health and Safety Policy



Health and Safety Policy

Originator	Reviewed By	Document No.	Original Issue	DCN #	Revision Date
P. Chhasatiya	Scott Hjelseth	SIL-HS-POL-001 Rev B	June 23, 2023	DCN 25-89	November 14, 2025

At Silfab Solar Inc., we put Health and Safety at the center of all aspects of our business. We are committed to keeping our employees safe by eliminating the occupational injuries and illness in all our facilities. We are firm believers of "Safety of the person is priority over all targets." And "Zero occupational injuries, although challenging, is an achievable goal, as all occupational incidents are preventable."

Silfab Solar Inc. is committed to,

- Remain in compliance with all applicable statutory requirements concerning Health and Safety.
- Take every reasonable precaution to eliminate occupational injury and causes of illness.
- Implement the Internal Responsibility System to hold all stakeholders accountable for their responsibilities towards maintaining the Health and Safety culture in the organization.
- Develop and Implement the Health and Safety programs and ensure the continuous improvement of their results and overall performance.
- Create a physically and psychologically safe work environment.

Silfab Solar Inc. strives to achieve these commitments by:

- Having regular review of the legal requirements and adjusting programs per changes in requirements.
- Ensuring all required resources are provided to eliminate occupational injuries and illnesses.
- Setting up clear expectations regarding Health and Safety related roles and responsibilities for all stakeholders, including contractors and subcontractors.
- Establishing Key Performance Indicator (KPI) Targets with planned projects to achieve them.
- Encouraging the involvement of all employees and working with them to create a safe working environment.

We recognize Health and Safety as a foundation to drive our future success. It is in the best interest of all stakeholders to practice Health and Safety as an integral part of life. We pledge to take all the necessary actions to ensure the safety of all those who work for or with Silfab Solar Inc.

Paolo Maccario

Paolo Maccario
Chief Executive Officer

Treff MacDonald

Treff MacDonald
Chief Operating Officer

Mike Boggs

Mike Boggs
Chief People Officer

Appendix C

Road Map of IMS

IMS Certification Plan ON Scope: HQ functions WA Scope: Module manufacturing SC Scope (Early 9001 cert option): Module Manufacturing SC Scope (IMS): Module & cell manufacturing	2025	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Preparation & Planning													
Finalizing consultant support	■ ■ ■												
Documentation assessment for existing certification (ISO 9001)	■ ■												
Upload documentation to BPR Hub Platform - ISO 9001	■ ■												
IMS - Internal gap Assessment (9001, 14001 & 45001)													
Site visit by consultant	■ ■								■				
Conducting gap assessment	■ ■						■						
Closing gaps found during gap assessment		■	■					■					
100% documentation compliance with ISO 9001, 14001, 45001		■				■					■		
Stage 1 certification Audit from registrar													
Readiness for ISO 9001 compliance (optional path for SC to achieve 9001 earlier)							■						
Readiness/stage 1 audit for IMS compliance (all three ISO standards)											■ ■ ■		
Closing gaps from readiness audit											■ ■ ■		
Final Certification audit													
ISO 9001 certification (optional path for SC to achieve 9001 earlier)							■						
Full IMS certification (ISO 9001, 14001, 45001)												■ ■ ■	

Legend	
Mississauga, ON	■
Burlington, WA	■
Fort Mill, SC	■

Appendix D

New Employee Orientation Procedure

LEARNING PLAN

Title: New Employee Orientation

Dept.: Production

Issue Date: 6/2/26

Rev. Date:6/2/26

Page: 1 of 7

Learning Plan for New Employees

Trainee:	
Trainer(s):	
Supervisor:	
Training Start Date:	
Expected Completion Date:	

LEARNING PLAN

Title: New Employee Orientation

Dept.: Production

Issue Date: 6/2/26

Rev. Date:6/2/26

Page: 2 of 7

Learning Plan for New Employees

Welcome to Silfab. This learning plan is designed to ensure each of you are fully informed and understand what being a Silfab employee entails. Upon Completion of this learning plan you will understand your roles and responsibilities as well as all safety requirements and what Silfab's responsibilities are to you. In order to ensure the Plant is always adequately staffed, staffing/training guidelines have been developed. The objective is to have each department/shift self-sufficient to cover all vacancies and vacations. It is the Plant's objective to maintain two employees qualified in each Job position per shift.

Training Objectives	Responsibility	Trainer Signature	Trainee Signature	Completion date/Test Score
Day 1				
Overview of Silfab	Human Resources			
Handbook/Policy Review	Human Resources			
Workplace Environment/Rules	Human Resources			
Benefits	Human Resources			
ADP Setup	Human Resources			
Safety Overview	Human Resources			
Training Objectives	Responsibility	Trainer Signature	Trainee Signature	Completion date/Test Score
Day 2				
5S Training Class	Production			
Cell Manufacturing Overview	Production			
Module Line Overview	Production			
Quality Overview	Quality			
Mechanical Comprehension Exam	Human Resources			
Environmental Overview	Environmental			

LEARNING PLAN

Title: New Employee Orientation

Dept.: Production

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Training Objectives	Responsibility	Trainer Signature	Trainee Signature	Completion date/Test Score
Day 2-4				
Active Shooter	Human Resources			
Arc Flash	Human Resources			
Bloodborne Pathogens	Human Resources			
Confined Space Attendant	Human Resources			
Confined Space Entrant	Human Resources			
Electrical Safety	Human Resources			
Emergency Action and Fire	Human Resources			
Fall Protection	Human Resources			
Fire Extinguisher Safe Use	Human Resources			
Forklift Operation	Human Resources			
Pedestrian Safety	Human Resources			
Hazard Communication	Human Resources			
Waste Container Management	Human Resources			
Facility Operation	Human Resources			
Hearing and Noise Conservation	Human Resources			
Lockout Tagout	Human Resources			
Personal Protective Equipment	Human Resources			
Process Safety Management	Human Resources			

LEARNING PLAN

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Training Objectives	Responsibility	Trainer Signature	Trainee Signature	Completion date/Test Score
Day 2-4				
Respiratory Protection	Human Resources			
Silica Dust	Human Resources			
Sexual harassment Prevention	Human Resources			
SPCC and FRP	Human Resources			
SPCC Plan	Human Resources			
SWPPP	Human Resources			
Training Objectives	Responsibility	HR Signature	Employee Signature	Completion date/Test Score
Day 5				
Review and Answer Questions on all policies/procedures	Human Resources			
Assigned to Department _____	Human Resources			N/A
Give Shift Assignments/Supervisor Name/Start Date and Time	Human Resources			N/A
Deliver New Employee Packets to Assigned Supervisor	Human Resources			N/A
If Salaried Take New Employee to Assigned Department Manager	Human Resources			N/A

Note: All Required safety classes must be completed and all PPE Issued prior to Trainees being allowed on production floor. The safety exams must be completed with a minimum passing score of 80%. Any failure will require retesting prior to working on the production floor.

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During the First Day on Shift the Supervisor will complete the following checklist:

Training Objectives	Responsibility	Supervisor Signature	Trainee Signature	Completion date
Week One On Shift				
Tour of Production Line	Supervisor			
Bathroom Location	Supervisor			
Review Floor Policies	Supervisor			
Review Shift Meeting Location	Supervisor			
Introduce New Employee to Team Leads and Team Members	Supervisor			
Review Procedure For Contacting Team Leads and Maintenance	Supervisor			
Introduction to First Assigned Station and review Job Description	Supervisor			
Review Break Times and Attendance Policy	Supervisor			
Explain Company and department KPIs	Supervisor			
Set Goals and Expectations for Employee	Supervisor			
Show employee location of SWIs and Stress the importance of using SWIs	Supervisor			
Introduce to Assigned Buddy and Complete the Attached Buddy Assignment Checklist.	Supervisor	N/A	N/A	N/A

New Employee Orientation Completed:

Trainee:_____

Human Resources:_____

Production Manager:_____

LEARNING PLAN

Title: New Employee Orientation

Dept.: Production

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Silfab Solar Buddy Checklist



New Hire's Name: _____ Title: _____
Hire Date: _____

Supervisor's Name: _____ Department: _____

Silfab Solar Buddy Name: _____ Title: _____

Date Checklist Started: _____ Date Checklist Completed: _____

- ☐ Department introductions (managers, supervisors, leads, and peers)
- ☐ Teams, shifts and schedules (start times, end times, break times)
- ☐ Complete facility tour including all bathrooms, break rooms, entrances, offices, etc.
- ☐ Key leadership personnel, who they are and what they do:
 - ☐ Operations/Plant Manager ☐ Quality Manager
 - ☐ Production Manager ☐ Maintenance Manager
 - ☐ HR Manager ☐ Warehouse Manager
 - ☐ Safety Manager ☐ Others as needed
- ☐ Tour and general explanation of Front End Line Operations (all lines)
- ☐ Tour and general explanation of Back End Line Operations (all lines)
- ☐ SOPs (where they're located, why they're important, and how to use them)
- ☐ Tour and general overview of the Shipping and Receiving (Warehouse) area
- ☐ Have lunch with the new employee
- ☐ Explanation of the call-out process
 - ☐ Verify the new employee has the Absenteeism Hotline phone number saved
- ☐ Safety briefing (marked walkways, emergency exits, first aid kits, eye washing stations, etc.)
 - ☐ Introduce SIFI program
 - ☐ Review safety glasses policy
 - ☐ Review safety footwear policy
- ☐ ADP Overview
 - ☐ Ensure the ADP app is downloaded to employee's phone

LEARNING PLAN

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Show the employee how to request time off

Show the employee how to view their paystubs

By signing below, I acknowledge that the above checklist has been completed thoroughly and as intended, in an effort to acclimate and welcome new Silfab Solar employees, ensuring their comfort, understanding and success.

New Hire's Signature: _____

Date: _____

Silfab Solar Buddy's Signature: _____

Date: _____

Supervisor's Signature: _____

Date: _____

Revision date: January 11, 2024

SIL-HR-CS-001 Rev A

DCN 24-05

Appendix E

Documentation Review List – SOPs

Facilities - Wet

HCl

HCl SOP from Unloading to VMB.docx
Facilities Unloading Hydrochloric Acid 1.009
Hydrochloric Acid Transfer from Storage Tank to Cell Line Valve Box

HF

HF SOP From Unloading to VMB.docx
Facilities Unloading Hydrofluoric Acid HF 1.009
Hydrofluoric acid transfer from storage tank to cell line valve box 1.009

KOH

KOH SOP from unloading to VMB.docx
Facilities Unloading Potassium Hydroxide KOH 1.014
Potassium Hydroxide (KOH) transfer from storage tanks to cell line valve box 1.000

Wet Tools

Batch Clean

Batch Clean SOP (2).pdf
Finishing-Production-of-Batch-Clean-Machine-1.000.pdf
Powering-Off-the-BatchClean-Machine-1.000.pdf
Power-on-Batch-Clean-Machine-1.000.pdf
Preparing-for-Automatic-Production(Batch-Clean)-1.000.pdf
Starting-Automatic-Production-BatchClean-Machine-1.000.pdf
Stopping-Automatic-Production-BatchClean-Machine-1.000.pdf

Batch Etch

Batch Etch SOP (2).pdf
Cold-Restart-of-PLC-on-the--BatchEtch-Machine-1.000.pdf
Finishing-Production-of-Batch-Etch-Machine-1.000.pdf
Powering-Off-the-BatchEtch-Machine-1.000.pdf
Power-On-BatchEtch-Machine-1.000.pdf

Starting-Automatic-Production-of-BatchEtch-Machine-1.000.pdf

Stopping-Automatic-Production-of-Batch-Etch-Tool-1.000.pdf

Batch Tex

Batch Texture SOP (2).pdf

Cold-Restart-of-PLC-on-the--BatchTex-Machine-1.000.pdf

Filling-BatchTex-Machine-Tanks-1.000.pdf

Finishing-Production-of-Batch-Tex-Machine-1.000.pdf

Powering-Off-the-BatchTex-Machine-1.000.pdf

Power-On-Batch-Texture-Machine-1.000.pdf

Starting-Automatic-Production-of-BatchTex-Machine-1.000.pdf

Stopping-Automatic-Production-of-BatchTex-Machine-1.000.pdf

Etch Side

InEtchSide SOP (2).pdf

Preparing-Automatic-Production---Inetch-Side-1.000.pdf

Shutting-off-Inetchside-machine-1.000.pdf

Starting-Production--InEtchSide-1.000.pdf

Stopping-Production--InEtchSide-1.000.pdf

Stopping-Production--Unplanned---InEtchSide-1.000.pdf

Switching-On-Inetch-side-Machine-1.000.pdf

Poly Side

InPolySide SOP (2).pdf

Power-On-Inpolyside-Machine-1.000.pdf

Starting-Production---InPolySide-1.000.pdf

Stopping-Production--Planned--Inpolyside-1.000.pdf

Stopping-Production-Unplanned--Inpolyside-1.000.pdf

Boron Diffusion Boat Cleaning

Graphite Boat Cleaner

LPCVD

Quartz Tube cleaner

Wafer Reword Cleaning

Waste Water Treatment

Wastewater emergency stop procedure 1.000

Wastewater Extended Shutdown maintenance Shutdown 1.001

Wastewater Normal Shutdown 1.000

Wastewater Startup Procedure 1.000

Facilities - Hot / Gases

Ammonia

Ammonia SOP from Unloading to VMB.docx
BSGS Operating Procedure for Ammonia Including emergency Stop 1.000
DVB_VMBs Startup to emergency Procedure 1.001
Emergency Response during Ammonia unloading 1.000
Facilities NH3 Ammonia Unloading 1.002

Silane

Silane SOP from Unloading to VMB.docx
Facilities Unloading Silane 1.002
Emergency Response during Silane Unloading 1.000
DVB-VMBs startup to Emergency Procedure 1.001
BSGS Operating Procedure for Silane Including Emergency Stop 1.000

Hot Tools

PECVD

PECVD Operating Procedure
PECVD Equipment Startup Procedure
PECVD Shutdown Procedure
PECVD Startup Procedure

LPCVD

LPCVD Combi Operating Procedure
LPCVD Equipment Shutdown Procedure
LPCVD Startup Procedure

Abatement

Local Scrubber

Local Scrubber Operating Procedure
Operating Procedure Local Scrubber Emergency Shutdown Procedure 1.000
Operating Procedure Local Scrubber Normal Operation 1.000
Operating Procedure Local Scrubber Shutdown Procedure 1.000
Operating Procedure Local Scrubber Startup Procedure 1.000

Acid Scrubber

Acid Scrubber SOP
Facilities Acid Scrubber startup and shutdown 1.000

Venturi

DFTO Venturi combi Operating procedure gemba links.docx

Maintenance

Wet Tools

Batch Clean

BatchClean-DI_O3-6-Month-Monitoring-1.000.pdf
BatchClean-DI_O3-Monthly-Cleaning-1.000.pdf
BatchClean-DI_O3-Weekly-Cleaning-1.000.pdf
BatchClean-Etch-1-+-2-Monthly-Cleaning-1.000.pdf
BatchClean-Etch-1-+-2-Weekly-Cleaning-1.000.pdf
BatchClean-Etch-1-+-2-Yearly-Monitor-1.000.pdf
BatchClean-Etch-1-2-Monthly-Monitor-1.001.pdf
BatchClean-Etch-6-Month-Monitoring-1.000.pdf
BatchClean-High-ETA-Clean-6-Month-Monitoring-1.000.pdf
BatchClean-High-ETA-Clean-Monthly-Monitor-1.000.pdf
BatchClean-High-ETA-Clean-Weekly-Monitor-1.000.pdf
BatchClean-High-ETA-Monthly-Cleaning-1.000.pdf
BatchClean-High-ETA-Weekly-Cleaning-1.000.pdf
BatchClean-Hot-Water-Dryer-Monthly-Monitor-1.000.pdf
BatchClean-Hot-Water-Dryer-Weekly-Cleaning-1.000.pdf
BatchClean-Hot-Water-Dryer-Weekly-Monitor-1.000.pdf
BatchClean-Loading-Module-8-Week-Cleaning-1.000.pdf
BatchClean-Loading-Module-Weekly-Cleaning-1.000.pdf
BatchClean-Load-Module-Monthly-Monitor-1.000.pdf
BatchClean-Machine-1-Month-Monitoring-1.000.pdf
BatchClean-Machine-6-Month-Monitor-1.000.pdf
BatchClean-Machine-Monthly-Cleaning-1.000.pdf
BatchClean-Machine-Weekly-Cleaning-1.000.pdf
BatchClean-Machine-Weekly-Monitoring-1.000.pdf
BatchClean-Rinse-1-+-2-Monitor-Weekly-1.000.pdf
BatchClean-Rinse-1-+-2-Monthly-Monitor-1.000.pdf
BatchClean-Rinse-1-+-2-Weekly-Cleaning-1.000.pdf
BatchClean-Transport-System-2-Week-Cleaning-1.000.pdf
BatchClean-Transport-System-Weekly-Cleaning-1.000.pdf
BatchClean-Unloading-Module-8-Week-Cleaning-1.000.pdf
BatchClean-Unloading-Module-Weekly-Cleaning-1.000.pdf
BatchClean-Unload-Module-Monthly-Monitor-1.000.pdf
BatchClean-Warm-Air-Dryer-1-Month-Monitor-1.000.pdf

BatchClean-Warm-Air-Dryer-1-Year-Cleaning-1.000.pdf
BatchClean-Warm-Air-Dryer-6-Month-Cleaning-1.000.pdf
BatchClean-Warm-Air-Dryer-6-Month-Monitoring-1.000.pdf
BatchClean-Warm-Air-Dryer-Weekly-Cleaning-1.000.pdf

Batch Etch

BatchEtch-DI_O3-6-Month-Monitoring-1.000.pdf
BatchEtch-DI_O3-Bath-Monthly-Monitor-1.000.pdf
BatchEtch-DI_O3-Monthly-Cleaning-1.000.pdf
BatchEtch-DI_O3-Weekly-Cleaning-1.000.pdf
BatchEtch-Etch-1-+2-6-Month-Monitoring-1.000.pdf
BatchEtch-Etch-1-+2-Monthly-Cleaning-1.000.pdf
BatchEtch-Etch-1-+2-Weekly-Cleaning-1.000.pdf
BatchEtch-Etch-1-+2-Yearly-Monitor-1.000.pdf
BatchEtch-Etch-1-2-Monthly-Monitor-1.000.pdf
BatchEtch-High-ETA-Clean-6-Month-Monitoring-1.000.pdf
BatchEtch-High-ETA-Clean-Monthly-Monitor-1.000.pdf
BatchEtch-High-ETA-Clean-Weekly-Monitor-1.000.pdf
BatchEtch-High-ETA-Monthly-Cleaning-1.000.pdf
BatchEtch-High-ETA-Weekly-Cleaning-1.000.pdf
BatchEtch-Hot-Water-Dryer-1-Month-Monitor-1.000.pdf
BatchEtch-Hot-Water-Dryer-Weekly-Cleaning-1.000.pdf
BatchEtch-Hot-Water-Dryer-Weekly-Monitor-1.000.pdf
BatchEtch-Loading-Module-8-Week-Cleaning-1.000.pdf
BatchEtch-Loading-Module-Weekly-Cleaning-1.000.pdf
BatchEtch-Load-Module-Monthly-Monitor-1.000.pdf
BatchEtch-Machine-1-Month-Monitoring-1.000.pdf
BatchEtch-Machine-6-Month-Monitor-1.000.pdf
BatchEtch-Machine-Monthly-Cleaning-1.000.pdf
BatchEtch-Machine-Weekly-Cleaning-1.000.pdf
BatchEtch-Machine-Weekly-Monitoring-1.000.pdf
BatchEtch-Rinse-1-4-Bath-Monthly-Monitor-1.000.pdf
BatchEtch-Rinse-1-4-Monitor-Weekly-1.000.pdf
BatchEtch-Rinse-1-4-Weekly-Cleaning-1.000.pdf
BatchEtch-Transport-System-2-Week-Cleaning-1.000.pdf
BatchEtch-Transport-System-Weekly-Cleaning-1.000.pdf
BatchEtch-Unloading-Module-8-Week-Cleaning-1.000.pdf

BatchEtch-Unloading-Module-Weekly-Cleaning-1.000.pdf
BatchEtch-Unload-Module-Monthly-Monitor-1.000.pdf
BatchEtch-Warm-Air-Dryer-1-4-1-Month-Monitor-1.000.pdf
BatchEtch-Warm-Air-Dryer-1-Year-Cleaning-1.000.pdf
BatchEtch-Warm-Air-Dryer-6-Month-Cleaning-1.000.pdf
BatchEtch-Warm-Air-Dryer-6-Month-Monitoring-1.000.pdf
BatchEtch-Warm-Air-Dryer-Weekly-Cleaning-1.000.pdf

Batch Tex

BatchTex-DI_O3-Monthly-Cleaning-1.000.pdf
BatchTex-DI_O3-Weekly-Cleaning-1.000.pdf
BatchTex-High-ETA-Monthly-Cleaning-1.001.pdf
BatchTex-High-ETA-Weekly-Cleaning-1.000.pdf
BatchTex-Loading-Module-8-Week-Cleaning-1.000.pdf
BatchTex-Loading-Module-Weekly-Cleaning-1.000.pdf
BatchTex-Machine-6-Month-Monitor-1.000.pdf
BatchTex-Machine-Monthly-Cleaning-1.000.pdf
BatchTex-Machine-Monthly-Monitoring-1.000.pdf
BatchTex-Machine-Weekly-Cleaning-1.000.pdf
BatchTex-Machine-Weekly-Monitoring-1.000.pdf
BatchTex-PSC1-Bath-Monthly-Cleaning-1.000.pdf
BatchTex-PSC1-Bath-Weekly-Cleaning-1.000.pdf
BatchTex-Rinse-1-and-2-Weekly-Cleaning-1.000.pdf
BatchTex-SDR-Bath-Weekly-Cleaning-1.000.pdf
BatchTex-Texture-Bath-Monthly-Cleaning-1.000.pdf
BatchTex-Texture-Bath-Weekly-Cleaning-1.000.pdf
BatchTex-Transport-System-2-Week-Cleaning-1.000.pdf
BatchTex-Transport-System-Weekly-Cleaning-1.000.pdf
BatchTex-Unloading-Module-8-Week-Cleaning-1.000.pdf
BatchTex-Unloading-Module-Weekly-Cleaning-1.000.pdf
BatchTex-Warm-Air-Dryer-1-Year-Cleaning-1.000.pdf
BatchTex-Warm-Air-Dryer-6-Month-Cleaning-1.000.pdf
BatchTex-Warm-Air-Dryer-Weekly-Cleaning-1.000.pdf

Etch Side

InEtch-Dryer_Output-8-Week-Cleaning-1.000.pdf
InEtch-Dryer_Output-Monthly-Monitor-1.000.pdf
InEtch-Dryer_Output-Weekly-Cleaning-1.000.pdf

InEtch-Input-8-Week-Cleaning-1.000.pdf
InEtch-Input-Monthly-Monitor-1.000.pdf
InEtch-Input-Weekly-Cleaning-1.000.pdf
InEtch-Input-Weekly-Monitor-1.000.pdf
InEtch-Machine-6-Month-Monitor-1.000.pdf
InEtch-Machine-Weekly-Monitor-1.000.pdf
InEtch-Process-Bath-Weekly-Cleaning-1.000.pdf
InEtch-Rinse-1-Weekly-Cleaning-1.000.pdf
InEtch-Side-Process-Bath-Monthly-Monitoring-1.000.pdf
InEtch-Side-Rinse-1-Monthly-Monitoring-1.000.pdf
InEtch-Transport-System-Monthly-Monitor-1.000.pdf
InEtch-Transport-System-Weekly-Monitor-1.000.pdf

Poly Side

InPoly-Dryer_Output-8-Week-Cleaning-1.000.pdf
InPoly-Dryer_Output-Monthly-Monitor-1.000.pdf
InPoly-Dryer_Output-Weekly-Cleaning-1.000.pdf
InPoly-Input-8-Week-Cleaning-1.000.pdf
InPoly-Input-Monthly-Monitor-1.000.pdf
InPoly-Input-Weekly-Cleaning-1.000.pdf
InPoly-Input-Weekly-Monitor-1.000.pdf
InPoly-Machine-6-Month-Monitor-1.000.pdf
InPoly-Machine-Weekly-Monitor-1.000.pdf
InPoly-Precon-Bath-Monthly-Monitoring-1.000.pdf
InPoly-Precon-Bath-Weekly-Cleaning-1.000.pdf
InPoly-Rinse-1---3-Monthly-Monitoring-1.000.pdf
InPoly-Rinse-1---3-Weekly-Cleaning-1.000.pdf
InPoly-Transport-System-Monthly-Monitor-1.000.pdf
InPoly-Transport-System-Weekly-Monitor-1.000.pdf

Hot Tools

PECVD

PECVD_Daily_PM_Gas-Pipeline-System.pdf
PECVD_DAILY_PM_Machine-Preparedness,-Appearance-and-Cleaning-procedure.pdf
PECVD_Daily_PM_PCW-System.pdf
PECVD_Monthly_PM_A_B-Side-Rotating-Furnace-Door.pdf
PECVD_Monthly_PM_Automatic-Boat-Loading-and-Unloading-Mechanism.pdf
PECVD_Monthly_PM_Gas-Pipeline-System.pdf

PECVD_Monthly_PM_Heating-System-1.000.pdf

PECVD_Monthly_PM_Paddle--Mechanism.pdf

PECVD_Monthly_PM_Process-Tube.pdf

PECVD_Monthly_PM_Vacuum-System.pdf

LPCVD

LPCVD_Auxiliary-Door_PM-Monthly.pdf

LPCVD_Cooling-water-system_Machine-PCW-temperature_PM-Daily.pdf

LPCVD_Cooling-Water-System_PCW-Paths_PM-Monthly.pdf

LPCVD_Cooling-Water-System_PCW-pressure-check_PM-Daily.pdf

LPCVD_Cooling-Water-System_Water-Flow-Detection-switch_PM--Before-Hand-over.pdf

LPCVD_Electrical-Control_Electrical-Components_PM-Monthly.pdf

LPCVD_Electrical-Control-System_Main-control-panel-and-Supply_PM-With-Tube-Change.pdf

LPCVD_Heating-System_Cooling-Fan_PM-Monthly.pdf

LPCVD_Heating-System_Furnace-Heating-Element_PM-With-Tube-Change.pdf

LPCVD_Heating-System_Heat-Exhaust_PM-Monthly.pdf

LPCVD_Heating-System_Main-Power-Line_PM-With-Tube-Change.pdf

LPCVD_Heating-System_Temperature-Control-Module_PM-With-Quartz-Tube-Change.pdf

LPCVD_Heating-System_Thermocouple_PM-With-Quartz-Tube-change.pdf

LPCVD_Lifters_PM-Monthly.pdf

LPCVD_Lifters_PM-Quarterly.pdf

LPCVD_Machine-Preparedness_PM-Daily.pdf

LPCVD_Machine-Preparedness-and-Cleanliness_PM-Monthly.pdf

LPCVD_Paddle-Assembly_PM-Quarterly.pdf

LPCVD_Paddle-Mechanism_Double-Paddle-Furnace-Door_PM-Monthly-1.000.pdf

LPCVD_Paddle-Mechanism_E-Stop_PM-Monthly.pdf

LPCVD_Paddle-Mechanism_Moving-parts,-motors-and-drivers_PM-Monthly.pdf

LPCVD_Paddle-Mechanism_Paddle-position-sensors_PM-Monthly.pdf

LPCVD_Paddle-Mechanism_Quartz-Boat-Entry_Exit_PM-Monthly.pdf

LPCVD_PC-Control-System_Display-Maintenance_PM-Daily.pdf

LPCVD_PC-Control-System_Equipment-Monitoring-System_PM-Monthly.pdf

LPCVD_PC-Control-System_Operating-System-Maintenance_PM-Quarterly.pdf

LPCVD_Pneumatic-and-Gas-System_Gas-Cabinet-Acid-Exhaust_PM-Monthly.pdf

LPCVD_Pneumatics-and-Gas-System_Pressure-Test-of-Gas-Pipelines_PM-After-Parts-Change.pdf

LPCVD_Pneumatics-and-Gas-Systems_Inspection-of-Gas-systems_PM-Daily.pdf

LPCVD_Process-Tube_PM-Monthly.pdf

LPCVD_Vacuum-Components_Main-Valve_PM-2-Months.pdf

LPCVD_Vacuum-System_Butterfly-Valve_PM-2-Months.pdf
LPCVD_Vacuum-System_Dry-Pump-Exhaust_PM-Monthly.pdf
LPCVD_Vacuum-System_Vacuum-and-Gas-Pipeline-joints_PM-Monthly.pdf
LPCVD_Vacuum-system_Vacuum-Dry-Pump_PM-Monthly.pdf

Abatement

Local Scrubber

Acid Scrubber

6-months-PM-for-Acid-Scrubber-1.000 (1).pdf
Monthly-PM-for-Acid-Scrubber-1.000 (1).pdf
Yearly-PM-for-Acid-Scrubber-1.000 (2).pdf

Venturi

PMs for Thermal Oxidizer and Venturi Scrubber 1.000

Alarms Documents

Name

Alarm overview.pdf
Rena light guide.jpg
rena tool alarm and errors.xlsx
Specification_SECSGEM_PV2-Adapter_BatchN3_Combi_19.8m_ProcessValues_Errors_V1.0.1.pdf
Specification_SECSGEM_PV2-Adapter_BatchN3_O3_18.6m_ProcessValues_Errors_V1.0.2.pdf
Specification_SECSGEM_PV2-Adapter_BatchN3_O3_22.3m_ProcessValues_Errors_V1.0.1.pdf
Specification_SECS-GEM_PV2-Adapter_InLine_ProcessValues_Errors_HWRel300_InEtchSide_V1.0.1.pdf
Specification_SECS-GEM_PV2-Adapter_InLine_ProcessValues_Errors_HWRel302_InPolySide_V1.0.1.pdf
Specification_SECS-GEM_PV2-Adapter_InLine_V3.0.2.pdf

Appendix F

Leak and Emergency Response Documents

Silfab provided the following documentation for the leak and emergency response evaluation.

Emergency Response Documents
Training records and certifications HOTZONE Training Books 1 and 2, Org Chart, 24-hr HazMat Tech Outline (Response folder 04-24-26), Training Records and Training Content in '25 ERT Training, '26 ERT Training, Hazwoper Training & SCBA Inspection folders
Training Matrix for ERT - including LMS (BLR - Training Today) PSM employee training report "Process Safety Management - BLR Course Report (All SC) (05-11-26)" & Training Transcript "Process Safety Management - BLR Training Today" as uploaded to Response/Training folder
Exercise and Drill Documentation included with Haz Mat training
Corrective action items noted in Drill Documentation with assignments
Fire Pump Test 1/23/26
TGMS system descriptions
Incident Documentation covering the KOH Spill on 03-03-26
Permits from State Fire Marshal and AHJ - 4 folders (Zone A-E, F, G, H - Fire Marsh Appr, Cert, Spec), 8 docs (Performance Fire Test Cert - Zone A - G, & Silane Canopy)
Silfab Facility Emergency Action Plan FEAP_rev5_MK_MASTER (03-07-26), Crisis Plan Overview_rev1_3-7-26 (Response 04-17-26); Vulnerability Assessment matrix from 2024
Silfab_FEAP_rev6, with regulatory cross-reference table, chemical response procedures, contact lists, decon procedure, drill schedule, evacuation maps and spill kit locations, first aid procedures, and area action plans
1 HS1002A First Aid Procedure (Response 05-07-26)
Life Safety Map_10.14.25 – showing evacuation routes and locations of spill kits
SDS <u>for</u> Potassium Hydroxide, Hydrofluoric Acid, Hydrochloric Acid, Ammonia, Silane
Slug Discharge Plan
Training Matrix included as RMP Element 15 rev 03/12/2026
SOPs as provided with the RMP: Wastewater Treatment Chemical Dispensing, Shutdown, Emergency Shutdown Unloading Procedures for HF, HCl, H2O2, KOH, Silane, Ammonia Air Handling Unit Shutdown
Table Top with Ft Mill School District and York Co EMA 5/20/26 with after-action report