

SEMICON West

2005



Bulk Spec Gas Solutions From People to Pipelines

SEMICON

2005

Bulk Spec Gas Solutions From People to Pipelines

Silane
(SiH₄) (2)



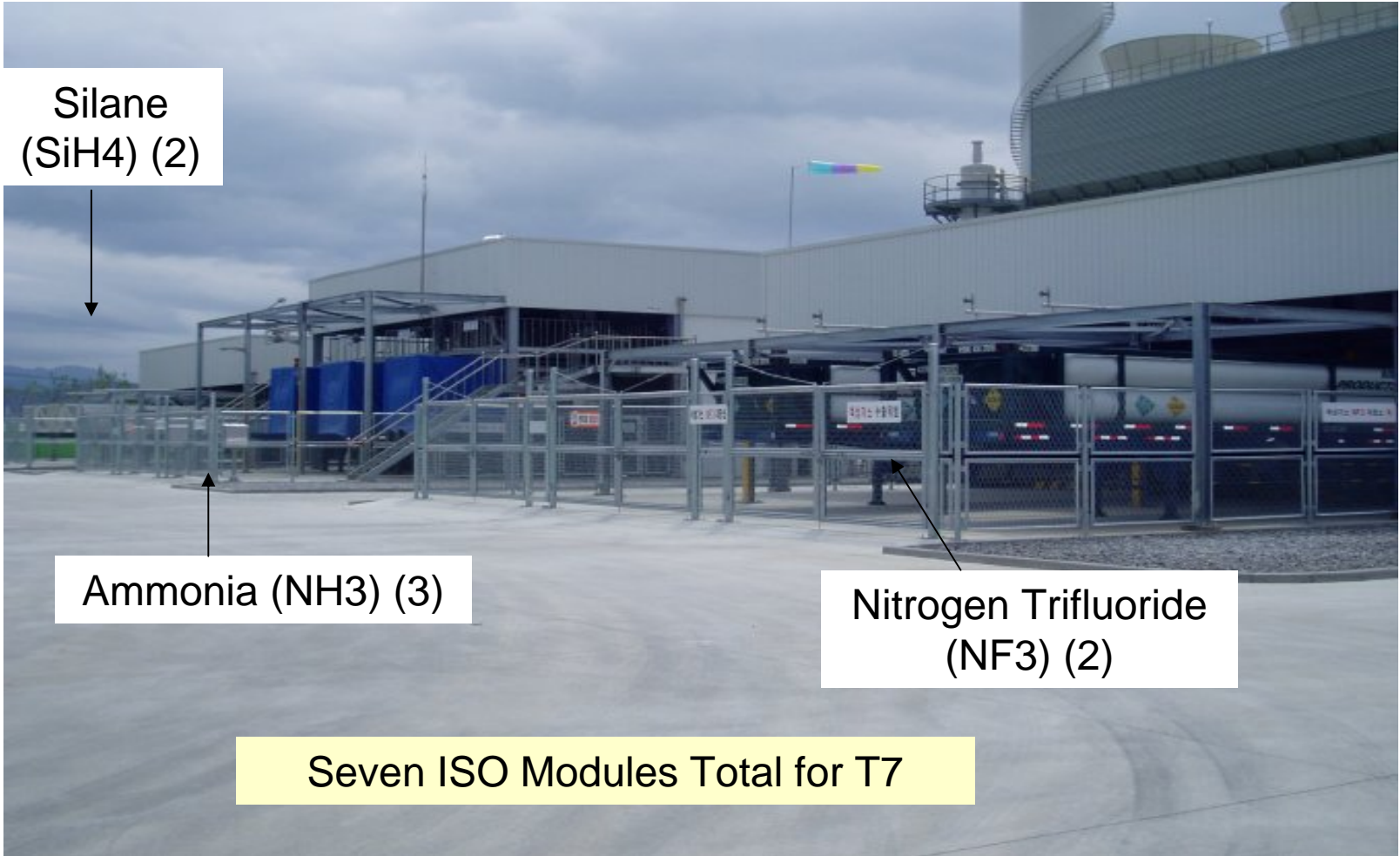
Ammonia (NH₃) (3)



Nitrogen Trifluoride
(NF₃) (2)



Seven ISO Modules Total for T7



SEMICON

2005

Benefits of APCI BSGS Solutions

- **Over 275 systems worldwide: Majority APCI Operations**
 - More than competitors combined
 - *ISO systems in operation* (NF3, NH3, SiH4, N2O, C2F6, etc.)
- **One stop shopping with focus on *solutions*:**
 - equipment . . . multiple bulk source options . . . total turnkey project . . . own & operate option
- ***Reduced cost of ownership* with bulk supply**
 - Lower capital, product & labor costs vs. cylinders, space saving
- **Better *consistency*, increased process quality**
 - Less variability in bulk gas purity vs. cylinders
- ***Enhanced reliability*, possibly increasing throughput**
 - Built-in redundancy for higher system uptime
- ***Improved safety*, giving peace of mind**
 - Less handling & connections, reducing potential exposure to hazardous gases
- **Most experience in building and operating BSGS**
 - Improvements with Project & Operations feedback

SEMICON

2005



AP Pipeline/BSGS Experience

- **Multiple UHP Bulk Gas Pipelines for Electronics**
 - Giehung, Gumi, Cheonan, Tainan, Silicon Valley, Phoenix, Kulim, Tianjin, Waigaoqiao
 - High reliability, single pipeline, ppb quality
 - >30 years experience (CA)
- **Over 300 *miles* of H₂/CO pipelines in Texas, Louisiana, California, Rotterdam, Brazil**
 - Most is underground, all single pipeline
 - Air Products has never had a toxic or serious fire related pipeline incident
- **ISO BSGS Pipeline experience**
 - Extensive pipeline experience around the world
 - Some feeding multiple fabs from one location

SEMICON

2005



AP BSGS Pipeline Standards

Safety and Reliability

- **Based on Global APCI Pipeline Design Standards**
 - Monitor annulus positive pressure
- **Gas specific correct conditions**
 - NH₃ heat trace from source container
 - NF₃ cleaned for oxidizer service
 - SiH₄ equipment open rack design
- **Own, Operate & Maintain by APCI:**
 - one stop shopping for integrated approach
 - single point of contact if problems
- **ISO BSGS systems should have fully attended operation for highest reliability and safety**
 - Change out of ISOs
 - Daily survey/inspection of ISO, BSGS & ROW
 - Routine maintenance & response to failures
 - ER

SEMICON

2005



Bulk NH₃ ISO BSGS Example Start with a Clean Sheet of Paper

Highest Purity NH₃ Distillation plant (1 PPB H₂O)



SEMICON

2005

Filled into Patented Heated ISO



SEMICON

2005





NH3 ISO BSGS Design Basis

- **1x1 ISO BSGS (1 on-line, 1 reserve)**
 - Smaller bulk cylinder backup is not best
- **NH3 system will be outdoors**
 - house scrubber may be used
- **Fire wall and Water Deluge may be required**
- **Standard APCI BSGS design**
 - redundant flow train with backup
 - Universal Pigtails with Controls on top of ISO
- **AP ISO Experience at Hometown PA & Korea plants, many customers in US & Asia**
- **Heat traced 316L EP SS coax pipeline w/ leak detection**
- **World's largest Spec Gas fleet**

SEMICON

2005



NH₃ System Safety – QRA / Consequence Modeling

- **Rigorous safety review done during design**
- **BSGS Isomodule Supply**
 - Done using US regulatory protocol
 - Modeled worst and alternate cases
 - Used for emergency planning
 - Automatic ISO valves lessens risk
- **NH₃ Pipeline**
 - Can model using catastrophic release
 - Can model using continuous release Include detection and mitigation features
 - Coaxial
 - Leak detection
 - Excess flow protection

SEMICON

2005

Other BSGS Gases to Pipeline

- **NF3: 1x1 ISO (1 on-line, 1 reserve)**
 - some feeding multiple fabs
 - Redundant flow train with backup
 - JT heater in BSGS
 - Sub US OSHA PSM offering ISO with Y back up
- **SiH4: Various sized ISO modules, 1 X 1 capacity**
 - Coaxial pipeline to prevent leaks
 - Experience in US & Asia with installed ISOs
 - Locations currently supplying multiple fabs
- **N2O: 1x1 ISO BSGS (1 on-line, 1 reserve)**
 - Y-cylinder backup system not recommended if flow rates high
 - Standard BSGS design: redundant backup flow train
- **Other Spec Gases done similar to those above**
 - Flammable, Oxidizer, Low vapor pressure liquefied, High pressure liquefied, & High pressure

SEMICON

2005

Summary

- **Many benefits of ISO BSGS pipeline supply:**
 - **Flow (only real option for large requirements)**
 - **Cost savings (gas room, capital, operating, product)**
 - **Reliability/consistency of supply**
 - **Improved safety (outside fab, fewer ISO changes)**
- **AP experience via own, operate & maintain of proven, conservative design for high reliability and safety**
- **Customer's input to our design/approach**
 - **peak/average flow rates required by tools**
 - **delivery pressures & temp. (60-80 psig, 40-70F)**
- **Assist in final approvals from local authorities on design requirements**
- **All the above ensure Spec Gas supply success.**