



EHS Services
and Solutions

SB01 Risk Management Plan 3-year Compliance Audit

Prepared for:

Apple, Inc.
3250 Scott Blvd,
Santa Clara, CA 95054

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Executive Summary

BSI EHS Services and Solutions (BSI), was retained by Apple, Inc. (Apple) to perform the three (3) year compliance audit of the Risk Management Plan for the facility in Santa Clara, CA located at 3250 Scott Blvd. Onsite activities occurred on April 1-4, 2019.

The assessment was performed to evaluate to evaluate compliance with requirements of the site specific Program 3 Prevention Program as required by 19 CCR 2760.8 and to provide Apple with a prioritized list of recommendations for consideration and corrective action. This assessment consisted of a site visit, covered process areas walkthrough, onsite and offsite documentation/records review, and selected employee interviews.

This assessment was performed to assess the level of compliance of the Risk Management Plan (RMP) California Accidental Release Prevention Program (CalARP) and associated implementation at the SB01 SPG site. This assessment included all elements of the program 3 risk management plan required by California Code of Regulations, Title 19 section 2735.1 to 2785.1 (19 CCR 2735.1-2785.1) The findings presented in this report are intended to to provide Apple a detailed report regarding its overall compliance with each specific regulatory element listed in the RMP and CalARP standards, and to identify compliance discrepancies requiring attention.

This report contains a RMP Findings Table summarizing the level of compliance and suggested corrective actions and program improvements.

Key positive observations from the audit include:

- Operational training and activities with Original Equipment Manufacturers (OEM) are well controlled and implemented
- Safety measures are well understood and practiced
- PHA and Process safety information is well documented
- Emergency Response Plan is comprehensive and the ERT program is well established
- Mechanical integrity program is well implemented and maintained

Key recommendations to assist Apple in complying with all RMP/CalARP elements include the following actions:

- Continue roll out of training and communication to ensure that all personnel that may be affected by a covered process have been trained to the level necessary for their job duties
 - Focus on general awareness and training. While many elements of the RMP are implemented at the site, awareness of the RMP itself and topic specific training such as Management of Change and Employee Participation Plan have not been fully rolled out. Additionally, provide emergency response training to all personnel.

- Develop an addendum to the existing EHSMS-GC-00, Construction EHS – General Conditions and Standards, rev March 2019, that is customized to applicable site process operations and fully implement all required elements of contractor safety requirements.
- Focus on documentation and records organization. Ensure one version of each document, accessibility and completeness.

Introduction and Scope of Work

Introduction

BSI EHS Services and Solutions (BSI), was retained by Apple, Inc. (Apple) to perform the three (3) year compliance audit of the Risk Management Plan for the facility in Santa Clara, CA located at 3250 Scott Blvd. Onsite activities occurred on April 1-4, 2019.

The assessment included a visual inspection of the covered processes at the facility including the following:

- Bulk Ammonia source
- Arsine source
- Chlorine source (MOCVD bunker location only, Chlorine in corrosive gas room not inspected)
- Emergency Ammonia Scrubber
- Abatement devices for Metal-Organic Chemical Vapor Deposition (MOCVD) systems (CS Clean and Jupiter Systems)
- General facility pad and exterior area

The assessment was conducted by Mr. Steve Trammell, PE, CSP, CCPSC, CHMM and Principal Consultant and Wendy Tredway, CHMM and Principal Consultant to evaluate the status of compliance with the RMP/CalARP standards at the time of the assessment, and to provide Apple with a list of compliance issues. This assessment consisted of a site visit, onsite and off site documentation review, and selected employee interviews. Quality and technical review was provided by Mr. Andrew McIntyre, CIH, Managing Principal of BSI.

This report presents the results of the audit, including one RMP findings table that summarizes the RMP compliance status, recommended corrective actions and best practice issues noted. The findings are prioritized based.

Site Work

Interviews, Documentation Review and Site Tour

The audit started with an RMP program overview and site tour followed by 3 days of interviews of selected Apple employees and contractor personnel knowledgeable about and responsible for operation and maintenance of the covered processes. Personnel interviewed and their area of responsibility associated with the RMP program are presented in the table below.

Name	Title	RMP Program Responsibility
Tom Huynh	SPG EHS Program Manager	Main RMP contact
Linda Vosper	SPG EHS Program Manager	Previous site EHS, providing historical information
Lyssa Green	EHS Specialist	BSI Consulting Specialist, RMP related tasks as directed by Apple
Dan Izumi	Facilities Engineer	Facilities Support and Maintenance
Dan Phillip	Equipment Engineer	Process Operations
Doug Williams	Equipment Engineer	Process Operations
Jack Kelly	Equipment Engineering Manager	Process Operations
Nathan Boskie	ACT Operations Supervisor	ACT contracted services
Ryan Spartz	ACT Project Manager	ACT contracted services
Gary Sanchez	Life Safety Systems Engineer	Gas Life Safety Systems contracted services
Tony Soriano	Facilities Manager	Facilities support and maintenance

During the interviews documentation associated with the RMP/CalARP element being discussed were reviewed. Additional offsite documentation review was completed as needed to assess compliance with each element. Documentation reviewed is listed within the findings table where applicable.

The full audit schedule is presented in Attachment 3.

Limitations

Experienced EHS professionals knowledgeable in the RMP and CalARP regulations conducted this assessment. The purpose of the assessment was to evaluate the status of RMP/CalARP program compliance at the time of the assessment. BSI did not investigate the veracity or thoroughness of representations made by Apple personnel during the assessment and accepts no liability for issues that were not identified during the assessment and which are later found to pose consequence. Furthermore, observations noted in this report were based on interviews with site personnel and physical observations of conditions that existed in the facility only on the day of this assessment.

This report was prepared for the exclusive use of Apple. No third party should rely on the contents or conclusions of this report without obtaining the prior written consent of BSI.

Results

Summary Documentation/Recommended Action Item Summary List

To facilitate tracking of action item completion, the recommended action items documented in the RMP Findings Table located in Attachment 2 are summarized in Attachment 1: Recommended Action Item Summary. This list is based on the consensus of the auditing team and should be periodically reviewed during action item completion cycle using total quality-type practices.

Attachment 1: Recommended Action Item Summary Table

Recommended Action Item Summary Table

#	Finding	#	Actions	Assigned	Response	Due Date
1.	The most recent General emergency response training for employees was rolled out during March 2019, to date during the audit no employees have completed. The deadline for completion is April 30, 2019.	1.	Ensure all employees have completed required training by the deadline of April 30, 2019.			
2.	Calibration is performed for emergency response equipment (Flex, Eagle), but this is not documented in the program.	2.	Include reference in the ERP "APPLE EHS-CRITICAL EQUIPMENT: INSPECTION, TESTING, CALIBRATION AND MAINTENANCE" where ERT equipment information is outlined. Verify that the EHS Critical Equipment program includes all Emergency response equipment.			
3.	3. ERP calls out the use of emergency equipment but does not detail the inspection, testing and maintenance of such equipment.	2.				
4.	While significant progress was made on action items, the timeframe for completion could be shortened and some action items are still in process. An excel file was created to track all action items, with target completion dates but it does not appear that the actions were fully communicated or followed through until recently. Action items from FMEA were not tracked or communicated to responsible personnel.	3.	Continue completion of all action items associated with hazard analyses.			
		4.	Develop a process to ensure thorough and complete communication of action items to ensure completion and resolution			

#	Finding	#	Actions	Assigned	Response	Due Date
5.	Arsine SOP and Chlorine SOP do not clearly outline emergency procedures. There is mention of a "leaker cabinet" being available in the MOCVD bunker.	5.	Review all SOP documents related to the covered processes to verify if emergency procedures are referenced. Add in a section within SOPs with emergency procedures or clearly state where this information can be found (e.g.: CMMS, manual, other document, etc.)			
6.	Training from OEMs is not documented	6.	Document the training provided by the OEMs and include the employee's identity, date of training and means used to verify that the employee understood the training.			
7.	The MOC checklists includes a section asking about completion of the Initial Risk Assessment. The Initial Risk Assessment or process of conducting it is not described in the program.	7.	Include a description of the "initial risk assessment" in the MOC program to clarify methodology used and how it is documented to determine the impact of change on safety and health.			
8.	Training on the MOC program has not yet occurred (planned for "a couple of weeks")	8.	Train all employees who are involved in operating a covered process, maintenance activities or whose job tasks are affected by changes to a process or part of process in the MOC procedure.			
9.	The FMEA conducted for the CS Clean installation resulted in action items to update the P&IDs and operating parameters tables, this action was not communicated or completed in a timely manner.	9.	Complete all actions from the CS Clean FMEA			
		10.	Fully implement the MOC program to ensure that all employees are trained in requirements of the process and all actions resulting from MOC and associated hazard analyses are communicated and completed.			
10.	Employee Participation Plan Training has been rolled out, however everyone interviewed had not received instructions or direction to take the training.	11.	Ensure all employees complete the training to increase awareness of the RMP and EPP			
11.	A comprehensive Construction Contractor Safety Management Program exists, however sections of it are not applicable to the site, and the applicable sections are not fully implemented.	12.	Create an addendum to the Contractor Safety Program, "EHS-MS-GC-00-Construction EHS - General Conditions and Standards" rev March 2019 to address SB01 applicability and conduct training on the additions to address all items that do not have specific findings listed in this section.			

#	Finding	#	Actions	Assigned	Response	Due Date
12.	A contractor evaluation process is in place at Apple, however it is not clear if that program extends to specific sites such as Aria. The site personnel did not know the process for locating the documentation associated with the contractor safety performance review.	13.	Work with procurement to learn the process for obtaining contractor safety performance information.			
13.	Interviews indicate that most contractor staff are trained prior to performing work, but some contractors such as Flagship or other internal departments (Apple Security) may not be fully trained on Hazards of the covered process related to their work.	14.	Implement contractor onboarding and training process to cover hazards of the covered process associated with all contractor activities covered by the RMP standard (i.e.: contractors performing non-incident tasks).			
14.	Contractors have not been fully trained on the Emergency Response Program.	15.	As part of contractor onboarding process, provide emergency response training. Document training and retain records.			
15.	It is unknown if ongoing contractor performance is being evaluated	16.	Work with procurement to determine if and ensure that ongoing contractor performance evaluation is being conducted.			
16.	16. Training on the covered process has not occurred so training records do not exist.	16.	Repeat – see finding #15 and action item #16			
17.	The most recent review of contractor safety performance is not known.	17.	Determine and document most recent review of contractor safety performance within the RMP document.			

Attachment 2: RMP Findings Table

Insert Excel findings table



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Regulatory Citation	RMP Element	Compliant	Not Compliant	N/A	Evidence of Compliance and/or reason for not applicable	Finding and/or Comments	Recommended corrective actions
2745.3	Executive Summary, a brief description of the following should be included: -accidental release prevention and emergency response policies at the facility -facility and regulated substances list -worst-case release scenario(s) and alternate release scenario(s), including administrative controls and mitigation measures to limit the distances for each reported scenario -general accidental release prevention program and chemical-specific prevention steps -five-year accident history -emergency response program planned changes to improve safety	x			Review of the RMP document, executive summary section	The site has a well written and organized emergency response plan, which includes all program elements as required by RMP. It was developed in 2016 and the the most recent update was completed in April 2019.	
2745.4	Offsite consequence analysis (program 2 and 3)	x					
	One worst case release scenario to represent all regulated toxic substances held above the threshold quantity	x					
	One worst case release scenario to represent all regulated flammable substances held above threshold quantity			x	No flammable substances		
	Additional worst-case scenarios for toxics or flammables if required by section 2750.3(a)(2)(c)			x	Not applicable - worst case scenarios represent all potential receptors		
	One alternative release scenario for each regulated toxic substance held above the threshold quantity	x					
	One alternative release scenario to represent all regulated flammable substances held above the threshold quantity			x	No flammable substances		
	For each scenario the following information should be submitted: -chemical name -physical state (toxics only) -bases of results (give model name if used) -scenario (explosion, fire, toxic gas release, or liquid spill and vaporization) -quantity released in pounds -release rate/min -release duration/min -wind speed and atmospheric stability class (toxics only) m/sec -distance to endpoint/miles public and environmental receptors within the distance -passive mitigation considered	x			All information included in the OCA within the RMP		

<p>2745.5 and 2750.9</p>	<p>Five year accident history - for each accidental release the following information should be submitted: -no accidents history -date, time and approximate duration of release -regulated substances released -estimated quantity released in pounds -types of release event and its source -weather conditions, if known -on-site impacts -known offsite impacts -initiating event and contributing factors if known -whether offsite responders were notified if known -operational or process changes that resulted from investigation of the release</p>			<p>x</p>	<p>Not applicable, no accidental releases</p>		
<p>2745.8 Emergency Response Program</p>							
	<p>Do they have a written emergency response plan?</p>	<p>x</p>			<p>Written "Emergency Response and Contingency Plan: Aria" dated April 2019</p>		
	<p>Does the plan include specific actions to be taken in response to an accidental release of a regulated substance?</p>	<p>x</p>			<p>Section 15, responding to a hazardous materials incident</p>		
	<p>Does the plan include procedure for informing the public and local agencies responsible for responding to accidental releases?</p>	<p>x</p>			<p>Section 18, Public information during and emergency Section 5, Emergency notification procedures</p>		
	<p>Does the plan include information on emergency health care?</p>	<p>x</p>			<p>Section 10, medical emergencies</p>		
	<p>Date of the most recent review or update of the emergency response plan</p>				<p>April 2019</p>		
	<p>Date of the most recent emergency response training for employees</p>				<p>The most recent emergency response trainings was conducted as follows: -ERT Haz Mat Tech was conducted on 12/6/18 -New hires receive general emergency response training on their first day onsite.</p>	<p>1. The most recent General emergency response training for employees was rolled out during March 2019, to date during the audit no employees have completed. The deadline for completion is April 30, 2019.</p>	<p>1. Ensure all employees have completed required training by the deadline of April 30, 2019.</p>
	<p>Name and telephone number of the primary local emergency response agency with which the plan is coordinated</p>	<p>x</p>			<p>The Santa Clara Fire Department, CUPA is mentioned several times throughout the document.</p>		

List of other federal or state emergency plan requirements to which the facility is subject	x		<p>Section one - scope. Outlines various regulations that apply including:</p> <ul style="list-style-type: none"> •California Code of Regulations, Title 8, Section 5192(q)(2) (8 CCR §5192(q)(2) – Hazardous Waste Operations and Emergency Response •29 Code of Federal Regulations Section 1920.120 – (29 CFR §1910.120(q) – Hazardous Waste Operations and Emergency Response •Code of Federal Regulations, Title 29, Section 1910.38 (29 CFR §1910.38) – Employee Emergency Plans •California Fire and Building Code – Requirements for H2, H3 and H4 Occupancies 		
2765.2 Emergency Response Program					
The owner or operator shall develop and implement an emergency response program for the purpose of protecting public health and the environment. The emergency response program shall include the following:					
An emergency response plan, which shall be maintained at the stationary source and contain at least the following elements:	x				
Procedures for informing and interfacing with the public and local emergency response agencies about accidental releases, emergency planning and emergency response;	x		Section 18, Public information during and emergency Section 5, Emergency notification procedures		
Documentation of proper first-aid and emergency medical treatment necessary to treat accidental human exposures;	x		Section 7 - identifying an emergency, medical Section 4 - ERT training calls out levels of CPR/AED/First aid and other chemical related training required		
Procedures and measures for emergency response after an accidental release of a regulated substance;	x		Section 7 - identifying an emergency, gas release		
Procedures for the use of emergency response equipment and for its inspection, testing and maintenance;		x		<p>2. Calibration is performed for emergency response equipment (Flex, Eagle), but this is not documented in the program.</p> <p>3. ERP calls out the use of emergency equipment but does not detail the inspection, testing and maintenance of such equipment.</p> <p>NOTE: The EHS Critical Equipment Program defines calibration and maintenance schedule for ERT equipment</p>	<p>2. Include reference in the ERP "APPLE EHS-CRITICAL EQUIPMENT: INSPECTION, TESTING, CALIBRATION AND MAINTENANCE" where ERT equipment information is outlined. Verify that the EHS Critical Equipment program includes all Emergency response equipment.</p>

	Training for all employees in relevant procedures and relevant aspects of the Incident Command System;	x			Section 6, Emergency Management and Response System	
	Procedures to review and update, as appropriate, the emergency response plan to reflect changes at the stationary source and ensure that employees are informed of changes.	x			Section 3 - roles and responsibilities, outlines that EHS is responsible for update of the plan Section 4 - training, identifies communication/training for changes made to the plan	
	A written plan that complies with the contingency plan format developed pursuant to Section 25503.4 of HSC and that, among other matters, includes the elements provided in section (a), shall satisfy the requirements of this section if the owner or operator also complies with section (c). The contingency plan format shall be provided to OES upon request.					
	The emergency response plan developed under section (A)(1) shall be coordinated with the community emergency response plan developed under section 11003 of title 42 of USC. Upon request of the local emergency planning committee or emergency response officials, the owner or operator shall promptly provide to the local emergency response officials information necessary for developing and implementing the community emergency response plan	x			The local emergency response agency, Santa Clara Fire Department, has received the ERP, worked closely with Apple to coordinate and conducted drills onsite with Apple personnel.	
	The owner or operator is not required to meet the business plan requirements if the emergency response plan developed under this section is consistent with the business plan requirements pursuant to sections 2731 and 2732 of Title 19 CCR. This does not exempt the owner or operator from requirements which relate to the annual inventory or emergency response planning for hazardous materials which are not regulated substances			x	not applicable, business plan and ERP in place.	
2745.9 Certification						
	<i>For program 1 processes the RMP certification statement provided in Section 2735.5(d)(4) should be submitted.</i>					
	For all other covered processes, a single certification that, to the best of the signer's knowledge, information, and belief formed after reasonable inquiry, the information submitted is true, accurate, and complete.	x			Section 6 - certification CalARP registration certification signed by Scott Sidlow, Apple Global EHS Manager (Now Director) on 2/22/2016	Note: most recent update of RMP has not been certified yet, but original submission was certified.
	RMP certified completed by a qualified person and the owner/operator (2745.2)	x			Section 6 - certification CalARP registration certification signed by Scott Sidlow, Apple Global EHS Manager (now Director) on 2/22/2016	
2745.1 RMP updates						
	<i>The owner/operator of a stationary source shall revise and update the RMP submitted under section 2745.1 as follows:</i>					
	Within 5 years of its initial submission or most recent update required by Sections (a)(2) through (a)(7), whichever is later			x	The 5 year date has not passed since the accepted submittal by the SCFD	

No later than three years after a newly regulated substance is first listed by the USEPA			x	No additions of new chemistry have been added to the existing regulated substance list since the development of the RMP	
No later than the date on which a new regulated substance is first present in an already covered process above threshold quantity			x	No additions of regulated substances have been added to the site	
No later than the date on which a regulated substance is first present above a threshold quantity in a new process			x	No new process or new listed chemistries	
Within 6 months of a change that requires a revised PHA or hazard review			x	Change occurred related to an abatement system, FMEA conducted. Risks associated with the process were decreased, not increased. Notification was not required	
Within 6 months of a change that requires a revised offsite consequence analysis as provided in section 27505.7; and			x	Administrative changes to volumes reduced volumes onsite and did not change the toxic end point or any other hazards associated with the existing processes. Changes to volumes conducted during 2019 update to RMP plan to provide more accurate accounting of cylinder volumes.	
Within 6 months of a change that alters the program level that applied to any covered process.			x	The RMP Program level (program Level 3) has not been downgraded	
<i>The owner operator of a stationary source which has regulated substances in a process listed in section 2770.5 in quantities greater than Table 3 thresholds and less than thresholds in Tables 1 or 2 shall revise and update the RMP submitted under section 2745.1. The updated RMP shall be submitted to the AA as follows:</i>					
Within five years of its initial submission or most recent update required by sections (b)(2) through (b)(7)			x	The 5 year date has not passed since the accepted submittal by the SCFD	
No later than three years after a newly regulated substance is first listed by the OES			x	No newly regulated substances listed by OES	
No later than the date on which a new regulated substance is first present in an already covered process above threshold quantity			x	No new regulated substances introduced	
No later than the date on which a regulated substance is first present above a threshold quantity in a new process			x	No new regulated substances present on site	
Within six months of a change that requires a revised PHA or hazard review			x	Change occurred, FMEA conducted. Risks associated with the process were decreased, not increased. Notification not required	

	Within six months of a change that requires a revised offsite consequence analysis as provided in section 2705.7; and			x	Administrative changes to volumes reduced volumes onsite and did not change the toxic end point or any other hazards associated with the existing processes. Changes to volumes conducted during 2019 update to RMP plan to provide more accurate accounting of cylinder volumes.		
	Within six months of a change that alters the program level applied to any covered process			x	Program level has not been altered		
	If a stationary source is no longer subject to the applicability requirements of section 2735.4(a)(1), the owner or operator shall submit a revised registration pursuant to Section 2740.1(a) to USEPA within six months of indicating that the stationary source is no longer covered. A copy of the revised registration shall also be submitted to the AA.			x	Source still subject to rule		
	If a stationary source is no longer subject to the applicability requirements of section 2735.4(a)(2) the owner or operator shall submit a revised registration pursuant to section 2740.1(b) to the AA within six months of indicating that the source is no longer covered.			x	Source still subject to rule		
	Revised RMPs shall be subject to the public review process outlined in Section 2745.2			x	Revised RMP has not been submitted. Apple to determine submittal date after all changes have been finalized.	NOTE: Expect public review process to apply during re-submission of updated plan	
	Within 30 days of a change in the owner or operator, the new owner or operator shall contact the AA to update registration information. The new owner or operator shall determine if RMP changes are necessary.	x			The only change that has occurred is the contact information for the person with direct supervisory responsibility for the RMP plan (Now Apple's Tom Huynh). The AA is aware of this change and it is incorporated into the current revision of the plan that is underway.		
2745.11 Covered Process Modification							
	When an owner or operator intends to make a modification to a stationary source relating to a covered process and the modification may result in a significant increase in either: the amount of regulated substances handled at the stationary source as compared to the amount of regulated substances identified in the stationary source's RMP, or the risk of handling a regulated substance as compared to the amount or risk identified in the stationary source's RMP, then the owner or operator shall do all of the following:			x	Modifications to the amount of regulated substance handled at the site or the risk of handling regulated substances has not occurred		

	Where reasonably possible, notify the AA in writing of the owner or operator's intent to modify the stationary sources at least five (5) calendar days before implementing any modifications. As part of the notification process, the owner or operator shall consult with the AA when determining whether the RMP should be reviewed and revised. Where prenotification is not reasonably possible, the owner or operator shall provide written notice to the AA no later than 48 hours following the modification.	x			The only change to the covered process that has occurred is the addition of a new abatement unit (additional, not replacement). The AA was notified via the city's permitting process prior to the installation and operation of the unit. An RMP update/revision was not required.	
	Establish procedures to manage the proposed modification, which shall be substantial similar to the procedures specified in Sections 2760.6 and 2760.7 and notify the AA that the procedures have been established.	x			Management of Change procedures are used for all changes associated with the covered processes.	
	The owner or operator of the stationary source shall revise the appropriate documents, as required pursuant to section (a), expeditiously, but not later than 60 days from the date of the stationary source modification.			x	Changes did not increase the volume of regulated substance or increase the risk of handling a regulated substance	NOTE: While the RMP document and risk associated were not effected by the addition of the CS Clean unit, the associated PSI information and process flow diagrams were. The FMEA conducted contained action items for updating these documents that were not fully communicated or carried out. See finding #4.
2745.12 Certificate of Occupancy						
	New or modified stationary sources shall comply with Section 65850.2(b) of the Government Code prior to the issuance of the certificate of occupancy.	x			Certificate of occupancy issued to the site and posted in facility	
2745.7 and Article 6 Program 3 Prevention Program						
	<i>For each Program 3 process, the owner or operator shall provide the following information. If the same information applies to more than one covered process, the owner or operator may provide the information only once, but shall indicate to which processes the information applies.</i>					
	Facility Name	x			All included in: - the CalARP Registration form (6/22/16) -RMP section 1, registration information	
	Process	x				
	NAICS code	x				
	Chemical name(s)	x				
2760.1 Process Safety Information						
	<i>Information pertaining to the hazards of the regulated substances in the process. The information shall consist of at least the following:</i>					NOTE: All PSI information located in the PHA files for the systems.
	Toxicity information	x			Contained in SDSs attached to PHAs	
	Permissible exposure limits	x			Contained in SDSs attached to PHAs	
	Physical data	x			Contained in SDSs attached to PHAs	
	Reactivity data	x			Contained in SDSs attached to PHAs	
	Corrosivity data	x			Contained in SDSs attached to PHAs	

Thermal and chemical stability data; and	x			Contained in SDSs attached to PHAs	
Hazardous effects of inadvertent mixing of different materials that could foreseeable occur.	x			Contained in SDSs attached to PHAs	
<i>Information concerning the technology of the process shall include at least the following:</i>					
A block flow diagram or simplified process flow diagram	x			Contained in PHA	
Process chemistry	x			Contained in PHA	
Maximum intended inventory	x			Contained in the site chemical inventory/list	
Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and	x			Contained in PHA	
An analysis of the consequences of deviations	x			Contained in PHA	
Where original technical information no longer exists, such information may be developed in conjunction with the PHA in sufficient detail to support the analysis			x	All technical information is available.	
<i>Information pertaining to the equipment in the process shall include:</i>					
Materials of construction	x			Contained in PHA	
Piping and instrument diagrams (P&IDs)	x			Contained in PHA	
Electrical classification	x			Contained in system design information (SOOs, P&IDs, equipment manuals, etc.)	
Relief system design and design basis	x			Contained in system design information (SOOs, P&IDs, equipment manuals, etc.)	
Ventilation system design	x			Contained in system design information (SOOs, P&IDs, equipment manuals, etc.)	
Design codes and standards employed	x			Contained in system design information (SOOs, P&IDs, equipment manuals, etc.)	
Material and energy balances for processes built after June 21, 1999; and			x	For the batch processes conducted using regulated chemicals the "process parameters" provide enough information to adequately perform the PHA and assess/address all hazards associated with process operation.	
Safety systems (e.g. interlocks, detection, or suppression systems)	x			Contained in system wide PHA and supplementary PSI files (for MOCVD reactors)	
The owner or operator shall document that equipment complies with recognized and generally accepted good engineering practices	x			Contained in system design information (SOOs, P&IDs, equipment manuals, etc.)	

For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the owner or operator shall determine and document that the equipment is designed, maintained, inspected, tested and operating in a safe manner			x	All equipment designed to current codes/standards which are listed in the design documents.		
Date on which the safety information was last reviewed or revised (2745.7(d))				September 2015 - initial development of PSI information in conjunction with the PHAs	NOTE: Supplementary PSI files were created and submitted for 3 of the MOCVD reactors per the request of the AA's third party consultant during the initial submittal process. The MOCVD reactors were originally not part of the sites's PHA or PSI files because of thorough and complete reviews completed by the OEM. Apple should revisit this with the regulator to understand if the PSI files for the MOCVD reactors are required. If they are required, PSI files should be created for the remaining 2 reactors (5 total)	
2760.2 Process Hazard Analysis (PHA)						
The owner or operator shall work closely with AA's in deciding which PHA methodology is best suited to determine the hazards of the process being analyzed. The owner or operator shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed:						
What-if	x			System wide PHA conducted using what-if analysis		
Checklist			x	not used		
What-if! Checklist			x	not used		
Hazard and Operability Study (HAZOP)	x		x	PSI files developed using HAZOP		
Failure Mode and Effects Analysis (FMEA)	x			FMEA used to conduct hazard analysis of addition of CS clean system (to supplement Jupiter system for abatement)		
Fault Tree Analysis; or			x	not used		
An appropriate equivalent methodology			x	not used		
The PHA shall address:						
The hazards of the process	x			Discussed within PHA document and RMP document		
The identification of any previous incident which had a likely potential for catastrophic consequences			x	New system design, no previous incidents		
Engineering and administrative controls applicable to the hazards and their interrelationships such as appropriate application of detection methodologies to provide early warning of releases. (Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors.);	x			Detection and controls discussed throughout PHA document		

Consequences of failure of engineering and administrative controls	x			Consequences of deviations discussed throughout PHA document		
Stationary source citing						
Human factors	x			Considered as part of what if analysis in each node within the PHA		
A qualitative evaluation of a range of the possible safety and health effects of failure of controls; and	x			Discussed throughout the PHA document		
The PHA shall included the consideration of external events, including seismic events, if applicable. PHAs completed for other programs where external events were not considered, shall be updated to include external events.	x			Considered as part of what if analysis in each node within the PHA		
The PHA shall be performed by a team with expertise in engineering and process operations, and the team shall include at least one employee who has experience and knowledge specific to the process being evaluated. Also, one member of the team must be knowledgeable in the specific PHA methodology used.	x			PHA participants listed within PHA document as attachment 4 - participants included representatives from EHS, engineering, process, Gas life safety, etc. Resumes provided for facilitators as an attachment to the PHA		
The owner or operator shall establish a system to promptly address the team's findings and recommendations; assure that the recommendations are resolved in a timely manner and that the resolution is documented; document what actions are to be taken; complete actions as soon as possible; develop written schedule of when these actions are to be completed; and communicated the actions to operating, maintenance and other employees whose work assignments are in the process and who may be affected by the recommendations or actions			x		<p>4. While significant progress was made on action items, the timeframe for completion could be shortened and some action items are still in process. An excel file was created to track all action items, with target completion dates but it does not appear that the actions were fully communicated or followed through until recently. Action items from FMEA were not tracked or communicated to responsible personnel.</p> <p>NOTE: It is acknowledged that Apple chose to complete all action items identified during the initial PHA sessions even though the risk level of all actions did not warrant this.</p> <p>It is acknowledged that there has been staff turnover related to ownership of the RMP on the EHS side contributing to confusion of ownership of some items.</p>	<p>3. Continue completion of all action items associated with hazard analyses.</p> <p>4. Develop a process to ensure thorough and complete communication of action items to ensure completion and resolution</p>
At least every five years after the completion of the initial PHA, the PHA shall be updated and revalidated by a team meeting the requirements in section 2760.2(d), to assure that the PHA is consistent with current process. Notwithstanding section 2760.2(c), updated and revalidated PHA(s) completed to comply with section 5189 of Title 8 of CCR are acceptable to meet the requirements of this section.				x	5 years has not passed since the original PHA	

The owner or operator shall retain PHAs and updates or revalidations for each process covered by this section, as well as the documented resolution of the recommendations for the life of the process.	x			PHAs are retained and available		
Date of completion of the most recent PHA or updated and the technique used (2745.7 (e))				September 2015		
Expected date of completion of any changes resulting from the PHA				TBD - some actions still in progress		
PHA shall address:						
Major hazards identified	x			Throughout PHA document		
process controls in use	x			Throughout PHA document		
mitigation systems in use	x			Throughout PHA document		
monitoring and detection systems in use	x			Throughout PHA document		
changes since the last PHA			x	These were the first PHAs conducted for the covered processes, no changes to incorporate.		
<i>The owner or operator shall submit the following external events analysis information:</i>						
Types of natural and human caused external events considered in PHA Section 2760.2	x			Each PHA node addresses the most credible natural and human caused external events including earthquake, fire/explosion, hostile act/sabotage, extreme weather, power failure and flood.		
Magnitude or scope of external events which were considered. If not known, the owner or operator of the stationary source shall work closely with the AA to determine what is required. If seismic events are applicable, the parameters used in the consideration of the seismic analysis and which edition of the Uniform Building Code was used when the process was designed.	x			Each PHA node addresses the most credible natural and human caused external events including earthquake, fire/explosion, hostile act/sabotage, extreme weather, power failure and flood.		
For each external event, with a potential to create a release of a regulated substance that will reach an endpoint offsite, apply Sections 2745.7 through (e)(6)	x			All information contained within the PHA files and associated "Apple RMP Tracking Items 10-13-15"		
Date of most recent field verification that equipment is installed and maintained as designed (2745.7(q)(4))				Operation and maintenance of the covered process systems (chlorine, arsine, ammonia) occur on a regular basis. Field verification that equipment is installed and maintained as designed is included as part of this ongoing monitoring. Daily visual inspections are conducted and monthly PMs		
2760.3 Operating Procedures						

<i>The owner or operator shall develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information and shall address at least the following elements:</i>				Reviewed the following procedures: -Semi gas Hazardous Gas SOP - Arsine MOCVD -SB01 Ammonia Columbian Exchange SOP -SOP chi Chlorine gas exchange		
<i>Steps for each operating phase:</i>						
Initial start up	x			Outlined in SOP, gas cabinet HMI provides detailed step by step instructions		
Normal operations	x			Contained in operations manuals		
Temporary operations			x			
Emergency shutdown including the conditions under which emergency shutdown is required, and the assignment of shutdown responsibility to qualified operators to ensure that emergency shutdown is executed in a safe and timely manner			x		5. Arsine SOP and Chlorine SOP do not clearly outline emergency procedures. There is mention of a "leaker cabinet" being available in the MOCVD bunker.	5. Review all SOP documents related to the covered processes to verify if emergency procedures are referenced. Add in a section within SOPs with emergency procedures or clearly state where this information can be found (e.g.: CMMS, manual, other document, etc.)
Emergency operations			x		see previous finding for emergency shutdown.	
Normal shutdown; and	x					
Start up following a turnaround, or after emergency shutdown.	x					
<i>Operating limits:</i>						
Consequences of deviation; and	x			PSI files and operations manuals provide operating parameters and potential consequences of deviation from specified operating procedures.		
Steps required to correct or avoid deviation	x			Reference PSI files and operations manuals		
<i>Safety and health considerations:</i>						
Properties of, and hazards presented by, the chemicals used in the process;	x			Reference SDS		
Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment;	x			Reference SDS		
Control measures to be taken if physical contact or airborne exposure occurs;	x			Reference SDS		
Quality control for raw materials and control of hazardous chemical inventory levels; and,	x			Reference SDS		
Any special or unique hazards.	x			Reference SDS		
Safety systems and their functions.	x					
Operating procedures shall be readily accessible to employees who work in or maintain a process.	x			SOPs are available on Box, within the CMMS system (where applicable), within equipment (gas cabinet HMI), and equipment manuals.		

	The operating procedures shall be reviewed as often as necessary to assure that they reflect current operating practice, including changes that result from changes in process chemicals, technology and equipment, and changes to stationary sources. The owner or operator shall certify annually that these operating procedures are current and accurate.	x				
	Date of most recent review or revision of operating procedures				October 2018	
	The owner or operator shall develop and implement safe work practices to provide for the control of hazards during operations such as lockout/tagout; confined space entry; opening process equipment or piping; and control over entrance into a stationary source by maintenance, contractor, laboratory or other support personnel. These safe work practices shall apply to employees and contractor employees.	x			Reference Aria Facility Critical Equipment Program and associated Safe work permits	
2760.4 Training						
	<i>Initial Training</i>					
	Each employee presently involved in operating a process, and each employee before being involved in operating a newly assigned process, shall be trained in an overview of the process and in the operating procedures as specified in Section 2760.3. the training shall include emphasis on the specific safety and health hazards, emergency operations including shutdown, and safe work practices applicable to the employee's job tasks.	x			Training on process related activities is provided by the Original Equipment Manufacturer through on the job training.	
	In lieu of initial training for those employees already involved in operating a process on June 21, 1999 an owner or operator may certify in writing that the employee has the required knowledge, skills and abilities to safely carry out the duties and responsibilities as specified in the operating procedures.			x	the process was not in operation prior to June 21, 1999	
	<i>Refresher training</i>					
	Refresher training shall be provided at least every three years, and more often if necessary, to each employee involved in operating a process to assure that the employee understands and adheres to the current operating procedures of the process. The owner or operator, in consultation with the employees involved in operating the process, shall determine the appropriate frequency of refresher training.	x			Training is provided by the OEM any time a process change is made.	
	<i>Training documentation</i>					
	The owner or operator shall ascertain that each employee involved in operating a process has received and understood the training required by this section. The owner or operator shall prepare a record which contains the identity of the employee, the date of training, and the means used to verify that the employee understood the training.		x		6. Training from OEMs is not documented	6. Document the training provided by the OEMs and include the employee's identity, date of training and means used to verify that the employee understood the training.
	Date of most recent review or revision of training programs.				March 2019	
	Type of training provided - classroom, classroom plus on the job, on the job				Training provided by OEMs is OTJ	
	Type of competency testing used				OTJ demonstration of skills	
27605.5 Mechanical integrity						

<i>(a) Application - sections (b) through (f) of this section apply to the following process equipment</i>					
<i>Pressure vessels and storage tanks</i>					
<i>Piping systems (including piping components such as valves)</i>					
<i>Relief and vent systems and devices</i>					
<i>Emergency shutdown systems</i>					
<i>Controls (including monitoring devices and sensors, alarms, and interlocks); and</i>					
<i>Pumps</i>					
(b) Written procedures - the owner or operator shall establish and implement written procedures to maintain the on-going integrity of process equipment	x			Mechanical integrity activities are tracked via the CMMS work order management system	
(c) Training for process maintenance activities the owner or operator shall train each employee involved in maintaining the on-going integrity of process equipment in an overview of that process and its hazards and in the procedures applicable to the employee's job tasks to assure that the employee can perform the job tasks in a safe manner.	x			Training is accomplished via OTJ and equipment overview by either the OEM (upon install) or through site personnel that received the OEM training.	
<i>(d) Inspection and Testing</i>					
Inspections and tests shall be performed on process equipment	x			Mechanical integrity activities are tracked via the CMMS work order management system	
Inspection and testing procedures shall follow recognized and generally accepted good engineering practices	x			All calibration, testing and maintenance activities are carried out according to manufacturer instructions and recommendations.	NOTE: there are some types of equipment where industry best practice is followed (e.g.: MFCs)
The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturer's recommendations and good engineering practices, and more frequently if determined to be necessary by prior operating experience.	x			All calibration, testing and maintenance activities are carried out according to manufacturer instructions and recommendations.	NOTE: there are some types of equipment where industry best practice is followed (e.g.: MFCs)
The owner or operator shall document each inspection and test that has been performed on process equipment. The documentation shall identify the date of the inspection or test, the name of the person who performed the test, the serial number or other identifier of the equipment on which the test was performed, a description of the inspection or test performed, and the results of the inspection or test.	x			All mechanical integrity activities are documented in the CMMS system	
Equipment deficiencies - the owner or operator shall correct deficiencies in equipment that are outside acceptable limits (defined by the process safety information in section 2760.1) before further use or in a safe and timely manner when necessary means are taken to assure safety operation.	x			All equipment is maintained within specifications. Process monitoring equipment alerts staff to issues that may arise and shutdown procedures ensure that equipment does not run if it is not safe to do so.	
<i>Quality assurance</i>					

In the construction of new plants and equipment, the owner or operator shall assure that equipment as it is fabricated is suitable for the process application for which they will be used.	x			Design specification documentation calls out all fabrication information		
Appropriate checks and inspections shall be performed to assure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions.	x			The site's SL1 and SL2 process (PSSR) verifies that the equipment has been installed according to specifications and all EHS requirements are in place prior to start-up/operation		
The owner or operator shall assure that maintenance materials, spare parts and equipment are suitable for the process application for which they will be used.	x			Anything other than replacement in kind requires an MOC review to ensure all materials, parts and equipment are suitable for the process application for which they will be used.		
Date of most recent review or revision of maintenance procedures				During CMMS implementation 2019		
Date of the most recent equipment inspection or test and the equipment inspected or tested				Regular maintenance, testing and inspections are performed, all documented in the CMMS system		
2760.6 Management of Change						
The owner or operator shall establish and implement written procedures to manage changes (except for "replacement in kind") to process chemicals, technology, equipment and procedures; and changes to stationary sources that affect a covered process.	x					
The procedures shall assure that the following considerations are addressed prior to any change:						
The technical basis for the proposed change	x			"Request for change form" section III		
Impact of change on safety and health			x	"Request for change form" section IV	7. The MOC checklists includes a section asking about completion of the Initial Risk Assessment. The Initial Risk Assessment or process of conducting it is not described in the program. NOTE: Consider adding "high risk" to the definitions to clarify the initial risk assessment and requirements for further EHS sign off (add to table in section IV)	7. Include a description of the "initial risk assessment" in the MOC program to clarify how it is accomplished to determine the impact of change on safety and health.
Modifications to operating procedures	x			"Request for change form" section VI		
Necessary time period for the change; and,	x			"Request for change form" section I (asks if it's temporary)		
Authorization requirements for the proposed change.	x			"Request for change form" section X (change authorization)	NOTE: Consider adding other groups/departments such as facilities, MOCVD or others that may be appropriate for sign off	

	Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process shall be informed of, and trained in, the change prior to start-up of the process or affected part of the process.		x			8. Training on the MOC program has not yet occurred (planned for "a couple of weeks")	8. Train all employees who are involved in operating a covered process, maintenance activities or whose job tasks are affected by changes to a process or part of process in the MOC procedure.
	If a change covered by this section results in a change in the process safety information required by Section 2706.1, such information shall be updated accordingly		x			9. The FMEA conducted for the CS Clean installation resulted in action items to update the P&IDs and operating parameters tables, this action was not communicated or completed in a timely manner.	9. Complete all actions from the CS Clean FMEA 10. Fully implement the MOC program to ensure that all employees are trained in requirements of the process and all actions resulting from MOC and associated hazard analyses are communicated and completed.
	If a change covered by this section results in a change in the operating procedures or practices required by Section 2760.3, such procedures or practices shall be updated accordingly.			x	No changes have resulted in operating procedure changes		
	Date of most recent change that triggered management of change procedures				June 19, 2017		
	Date of most recent review or revision of management of change procedures				March 2019		
2760.7 Pre-Startup Review							
	The owner or operator shall perform a pre-startup safety review for new stationary sources and for modified stationary sources when the modification is significant enough to require a change in the process safety information.	x			PSSR activities are conducted using the site's SL1 and SL2 checklists		
	The pre-start up safety review shall confirm that prior to the introduction of regulated substances to a process;						
	Construction and equipment is in accordance with design specifications;	x			Design requirements captured in individual line items and verified during each sign off level in the SL1, 2 and 3 checklists.		
	Safety, operating, maintenance, and emergency procedures are in place and adequate;	x			SL3 checklists include checks for operational and maintenance procedures. SL2 checklist includes a line item to verify that ERT coordinator is familiar with emergency shutdown procedures.		
	For new stationary sources, a PHA has been performed and recommendations have been resolved or implemented before start up, and modified stationary sources meet the requirements contained in management of change, Section 2760.6; and,	x			Initial system wide PHA included review of all stationary sources.		
	Training of each employee involved in operating a process has been completed.		x			See previous finding regarding training	
	Date of most recent pre-startup review				all systems were reviewed using the SL1 and SL2 checklists during formal pre-start up review conducted at install prior to operation in 2015.		
2760.8 Compliance Audits							

The owner or operator shall certify that they have evaluated compliance with the provisions of this article at least every 3 years to verify that he procedures and practices developed under the chapter are adequate and are being followed.	x			Compliance audit (this audit) is the first 3 year compliance audit conducted for the facility. The audit occurred onsite April 1-4 2019.		
The compliance audit shall be conducted by at least one person knowledgeable in the process.	x			Personnel conducting the audit, Wendy Tredway, CHMM and Principal Consultant and Steve Trammell, PE, CSP, CCPSC, CHMM and Principal Consultant of BSI are familiar with the covered processes. All staff personnel interviewed during the audit are also familiar with the process.		
A report of the findings of the audit shall be developed.	x			This checklist and summary letter serves as the audit report		
The owner or operator shall promptly determine and document an appropriate response to each of the findings of the compliance audit, and document that deficiencies have been corrected.			x	Apple will proceed with corrective actions after acceptance of the audit report		
The owner or operator shall retain the two most recent compliance audit reports.			x	This is the first compliance audit		
Date of the most recent compliance audit				April 1-4, 2019		
Date of completion of any changes resulting from the compliance audit.				To be determined by Apple after receipt of the report		
2760.9 Incident investigation						
The owner or operator shall investigate each incident which resulted in, or could reasonably have resulted in, a catastrophic release of a regulated substance.			x	There have been no incidents since the process started operation.		
An incident investigation shall be initiated as promptly as possible, but not later than 48 hours following the incident.			x	There have been no incidents since the process started operation.		
An incident investigation team shall be established and consist of at least one person knowledgeable in the process involved, including a contract employee if the incident involved work of the contractor, and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident.			x	There have been no incidents since the process started operation.	NOTE: while there have been no incident investigations, Apple's process involves requirements to include all appropriate and knowledgeable personnel in the investigation process.	
A report shall be prepared at the conclusion of the investigation which includes at a minimum:			x	There have been no incidents since the process started operation.	NOTE: While there have been no incidents with the systems requiring reporting, the Apple incident reporting form and process meets all requirements in the event an incident does occur.	
Date of incident						
Date investigation began						
A description of the incident						
The factors that contributed to the incident; and,						
Recommendations resulting from the investigation.						

	The owner or operator shall establish a system to promptly address and resolve the incident report findings and recommendations. Resolutions and corrective actions shall be documented.	x			The Apple incident investigation process meets all requirements		
	The report shall be reviewed with all affected personnel whose job tasks are relevant to the incident findings including contract employees where applicable.			x	No incidents have occurred triggering incident investigation		
	Incident investigation reports shall be retained for five years.			x	No incidents have occurred triggering incident investigation		
	Date of the most recent incident investigation			x	No incidents have occurred triggering incident investigation		
	expected date of completion of any changes resulting from the investigation.			x	No incidents have occurred triggering corrective actions		
2760.10 Employee Participation							
	The owner or operator shall develop a written plan of action regarding the implementation of the employee participation required by this section.	x			A written employee participation plan exists		
	The owner or operator shall consult with employees and their representatives on the conduct and development of PHA and on the development of the other elements of process safety management in this chapter.			x		10. Training has been rolled out, however everyone interviewed had not received instructions or direction to take the training. NOTE: There is little awareness of the EP program, however that should be resolved after training is accomplished.	11. Ensure all employees complete the training to increase awareness of the RMP and EPP
	The owner or operator shall provide employees and their representatives with access to PHAs and to all other information required to be developed under this chapter.	x			All PHA documentation is available through the EHS team.		BMP - Determine a appropriate storage location for the PHA and other information that would be easily accessible to all employees without having to request it from EHS
	Date of the most recent review or revision of employee participation plans				April 4, 2019	NOTE: Date of plan pulled from Box file (upload date). Consider adding a date the plan to track revisions.	
2760.11 Hot Work Permit							
	The owner or operator shall issue a hot work permit for hot work operations conducted on or near a covered process.	x					
	The permit shall document that the fire prevention and protection requirements in Section 5189 of Title 8 of CCR have been implemented prior to beginning the hot work operations; it shall indicate the date(s) authorized for hot work; and identify the object on which hot work is to be performed. The permit shall be kept on file until completion of the hot work operations.	x				NOTE: Tony handles hot work permits for facilities - permit system, fire watch initiated through ERT for types of work that disable sprinklers or fire alarm system Doug and Dan can issue hot work permits also	
	Date of the most recent review or revision of hot work permit procedures.				The Hot Work Program is dated March 2013, with review scheduled to occur by the end of Apple's Fiscal year 2019 Q2 (March 2019).		

2760.12 Contractors						
Application. This section applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process. It does not apply to contractors providing incidental services which do not influence process safety, such as janitorial work, food and drink services, laundry, delivery or other supply services.		x			11. A comprehensive Construction Contractor Safety Management Program exists, however it is not entirely applicable to the site or fully implemented.	12. Create an addendum to the Global Program to address SB01 applicability and conduct training on the additions to address all items that do not have specific findings listed in this section.
<i>Owner or operator responsibilities.</i>						
The owner or operator, when selecting a contractor, shall obtain and evaluate information regarding the contract owner or operator's safety performance programs.		x		Interviews with staff and review of the Construction Contractor Safety program show that procurement is responsible for evaluation of contractor safety performance during the initial contracting process	12. A contractor evaluation process is in place at Apple, however it is not clear if that program extends to specific sites such as Aria. The site personnel did not know the process for locating the documentation associated with the contractor safety performance review.	13. Work with procurement to learn the process for obtaining contractor safety performance information.
The owner or operator shall inform the contract owner or operator of the known potential fire, explosion, or toxic release hazards related to the contractor's work and the process.		x			13. Interviews indicate that most contractor staff are trained prior to performing work, but some contractors such as Flagship or other internal departments (Apple Security) may not be fully trained on Hazards of the covered process related to their work. Note: training of other contractors working directly with the covered processes is in place.	14. Implement contractor onboarding and training process to cover hazards of the covered process associated with all contractor activities covered by the RMP standard (i.e.: contractors performing non-incident tasks).
The owner or operator shall explain to the contract owner or operator the applicable provisions of Article 7		x			14. Contractors have not been fully trained on the Emergency Response Program.	15. As part of contractor onboarding process, provide emergency response training. Document training and retain records.
The owner or operator shall develop and implement safe work practices consistent with Section 2760.3(d), to control the entrance, presence, and exit of the contract owner or operator and contract employees in covered process areas.	x			Site access and access to areas with covered processes is strictly controlled through badge readers.		
The owner or operator shall periodically evaluate the performance of the contract owner or operator in fulfilling their obligations as specified in section (c).		x			15. It is unknown if ongoing contractor performance is being evaluated	16. Work with procurement to determine if and ensure that ongoing contractor performance evaluation is being conducted.
<i>Contract Owner or operator responsibilities</i>						
The Contract owner or operator shall assure that each contract employee is trained in the work practices necessary to safely perform his or her job	x			Interviewed with ACT indicates that training is well organized and covers the work practices necessary to safely perform their job. Non-routine work is planned via Safe Work Plans that include training for personnel involved.		

The contract owner or operator shall assure that each contract employee is instructed in the known potential fire, explosion, or toxic release hazards related to his or her job and the process and the applicable provisions o of the emergency action plan		x			See previous finding for contractor training. ACT (hazardous waste service provider) was interviewed and all standard required training records were in place and readily available (HAZWOPER, HazMat Tech, etc.). Training on the covered processes, RMP and associated hazards was not formally received.	Repeat - See finding #14 - Implement contractor onboarding and training process to cover hazards of the covered process associated with all contractor activities covered by the RMP standard (i.e.: contractors performing non- incidental tasks).
The contract owner or operator shall document that each contract employee has received and understood the training required by this section. The contract owner or operator shall prepare a record which contains the identity of the contract employee, the date of training, and the means used to verify' that the employee understood the training.		x			16. Training on the covered process has not occurred so training records do not exist.	Repeat - see finding #15 - Document training and retain records.
The contract owner or operator shall assure that each contract employee follows the safety rules of stationary source including the safety work practices required by section 2760.3(d)	x			Contractors are well controlled, safe work practices are in place and followed. Safe work authorization and Safety work permit orientation training materials are in place.		
The contract owner or operator shall advise the owner or operator of any unique hazards presented by the contract owner or operator's work, or of any hazards found by the contract owner or operator's work.	x			Safe Work Plans are prepared for any non-routine tasks and clearly outline the hazards of the work that will be completed, mitigations in place and emergency procedures to follow.		
Date of the most recent review or revision of contractor safety procedures				March 2019 - EHSMS-GC-00 Construction EHS General Conditions and Standards Other Safe work permits (August 2015) -confined space entry -energized electrical work -excavation -fire protection-security systems impairment -gas detection system impairment -hot work -mobile crane -non-routine high hazard -working from heights	See previous comments/finding regarding development of a site specific contractor safety management program.	
Date of most recent evaluation of contractor safety performance.				unknown	17. The most recent review of contractor safety performance is not known. NOTE: there is a place holder within the RMP document for this information.	17. Determine and document most recent review of contractor safety performance within the RMP document.

Attachment 3: Audit Schedule



RMP Schedule.pdf

Start Time	End Time	Location	Topic	Discussion Details	Session Attendees
Monday, April 1					
2:00 PM	2:30 PM	Basso	Opening Meeting	The BSI Auditors, Wendy Tredway and Steve Trammell, shall provide a 30 minute overview of the audit process for the next three days.	Austin DeBaene Chuck Griggs Dan Izumi Dan Philipp Doug Williams Gary Sanchez Jack Kelly Linda Vosper Lyssa Green Nathan Boskie Ryan Spartz Tom Huynh Tony Soriano
2:30 PM	4:00 PM	Basso	RMP Program Overview and Site Walk	SB01's EHS shall provide an overview of the RMP and conduct a site walk to show Auditors the covered processes.	Linda Vosper Tom Huynh
Tuesday, April 2					
8:00 AM	9:00 AM	Colnago	Emergency Response Program	The session will be a review of the Emergency Response Program, key components, and walkthrough if needed.	Austin DeBaene Lyssa Green
9:00 AM	11:00 AM	Colnago	Covered Process Modification	The session will be a review of the Covered Process Modifications with the review of associated documentation and include a walk of the system changes.	Dan Izumi Dan Philipp
11:00 AM	12:00 PM	Colnago	Incident Investigation	Review of information around incidents.	Tom Huynh
1:00 PM	2:00 PM	Cervelo	PSI and PHA	The session will cover Process Safety Information (PSI) and Process Hazard Analysis (PHA). The interview discussion will focus on action items and closure status (FMEA).	Dan Izumi Linda Vosper Tom Huynh
2:00 PM	4:00 PM	Cervelo	Operating Procedures	The session will cover Operating Procedures. Attendees will provide a list of operating procedures (maintenance and O&M). The auditors will randomly select 1-2 and talk through them with the SME.	Dan Izumi Dan Philipp Doug Williams Doug Williams
Wednesday, April 3					

8:00 AM	9:00 AM	Cervelo	Training	This session will review records and interview operators. *Note: Auditors requested to observe any tasks/processes involving operators, tool vendors, maintenance or contractors during the audit time.	Jack Kelly Linda Vosper Nathan Boskie Ryan Spartz
					Tom Huynh
9:00 AM	12:00 PM	Cervelo	Maintenance and Mechanical Integrity	The session will focus on the Facilities and Operational activities relating to maintenance and mechanical integrity. Discussion will focus on procedures for MI, testing MI, and inspection records. Attendees must bring GLSS system maintenance and inspection records for the Auditors to review during the session.	Gary Sanchez Tony Soriano
2:30 PM	3:30 PM	Col du Tourmalat (WY01)	Management of Change	The session will focus on actual changes, MOC forms, and all associated follow through.	Linda Vosper Tom Huynh
3:30 PM	4:30 PM	Col du Tourmalat (WY01)	Pre-Startup Safety Review	The session will start with a review of initial PSSR record and then reviewing any PSSRs that have occurred since (SL1/SL2). They will also discuss and review the PSSR (equipment SL) procedure.	Linda Vosper Tom Huynh
Thursday, April 4					
8:00 AM	9:00 AM	De Rosa	Maintenance and Mechanical Integrity (Part 2)	This session will only be required if additional time is necessary to complete the Maintenance and Metical Integrity morning session.	Tony Soriano
10:00 AM	11:00 AM	Basso	Employee Participation Plan	The session will focus on actual changes, MOC forms, and all associated follow through.	Dan Izumi Dan Philipp Doug Williams Jack Kelly
11:00 AM	12:00 PM	Basso	Hot Work Program	The session will include a review of the Hot Work Program, documentation, and a review of past Hot Work permits.	Tony Soriano
1:00 PM	2:00 PM	Basso	Contractor Safety	The session will include a review of the Contractor Safety Program, all associated requirements, and training documentation	Lyssa Green Tom Huynh

3:00 PM	4:30 PM	De Rosa	Closing Meeting	The BSI Auditors will present their findings and facilitate a discussion with site personnel	Austin DeBaene Chuck Griggs Dan Izumi Dan Philipp Doug Williams Jack Kelly Linda Vosper Lyssa Green Nathan Boskie Ryan Spartz Tom Huynh Tony Soriano
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Attachment 4: Auditor Qualifications



Tredway W.pdf



Trammell S.pdf

Wendy Tredway

Principal Consultant

Summary of Experience

Ms. Tredway has over 15 years of professional experience in the environmental, health and safety field with experience ranging from program creation and management to technical support. During her professional experience she has gained a working knowledge of various environmental compliance requirements including Hazardous Materials/Wastes Management, Stormwater Pollution Control, Air Quality Management, Underground Storage Tanks and Permit By Rule/Conditionally Authorized Treatment Systems. She has also successfully provided environmental support for facility closures, including asbestos removals, decontamination activities and hazardous waste treatment system closures. Ms. Tredway specializes in site inspections, audits, permitting, reporting and Management System creation including ISO 14001. Additionally, she has provided strategic and tactical EHS support to a variety of industries including facility build out, design review and Process hazard analysis for equipment and facility processes.

Professional Certifications and Memberships

Certified Hazardous Materials Manager, Institute of Hazardous Materials Management (#15787)

Education

BS, Environmental Studies, Concentration EHS, Minor Chemistry CSU, San Jose
Hazardous Materials Management Certification UCSC extension, Santa Clara
ISO 14001 Lead Auditor Certification EORM, Sunnyvale

Supervision and Leadership Academy City of San Jose, San Jose

Professional Experience

BSI EHS Services and Solutions

Principal Consultant January 2011 to Present

Provides EHS project support to a variety of clients. Some areas of expertise include:

- General facility environmental health and safety compliance assessments to determine applicable regulations, compliance status and development of management systems to support regulatory requirements.
- Environmental Program development such as Hazardous Materials Management, Hazardous Waste Management, SWPPP, SPCC, Air Quality Management, Chemical Hygiene, etc.
- Safety Program development such as IIPP, Hazard Communication, Respiratory Protection, Bloodborne Pathogen Exposure Control, etc.
- Environmental Management System support including ISO 14001 internal audits, pre-registrar audit preparation support, and registrar audit support.
- Environmental compliance and permitting including BAAQMD projects, industrial waste water discharge, permit by rule, hazardous materials management, facility closures, toxic release inventory reporting, etc.
- Site evaluations for Storm Water Pollution Prevention, Spill Prevention Countermeasures and Control Plans.
- Hazardous waste management including EPA ID number applications, waste determinations, collection strategies, DTSC questionnaires, biennial reporting, Hazardous Waste Management Program development, SB14, generator status determination, etc.
- Hazardous Materials management including inventories and chemical classifications, hazardous materials business plan development and submittal, chemical storage and containment strategies, training, etc.
- Facility build out support including design review, process hazard analysis and associated facility and equipment permitting.

City Of San Jose, Environmental Services Department, San Jose, CA

Environmental Health and Safety Manager August 2007 to January 2011

Provided overall environmental health and safety support for a department of over 500 employees with work environments ranging from heavy industrial to office.

- Environmental compliance support for entire department including hazardous waste management, SPCC plans, general laboratory compliance, hazardous materials management, and BAAQMD permits.
- Occupational health and safety support for all divisions including Wastewater Management (heavy industrial), Watershed Protection (field workers), Water Resources (light industrial) and all Environmental Services Department functions located at City hall.
- Development of an Environmental Management System and successful ISO 14001 registration for the Water Resources Division.

Environmental and Occupational Risk Management, Inc., Sunnyvale, CA

EHS Consultant July 2005 to August 2007

Acting HSE-MS Corporate Compliance Officer for EORM's ISO14001 and OSHAS 18000 registration.

Provided EHS project support to a variety of clients. Some examples of project work include:

- General facility environmental assessments to determine applicable regulations, compliance status and development of management systems to support regulatory requirements.
- ISO 14001 facility audits, pre-registrar audit preparation support, and registrar audit support. Facilitation of aspects and impacts reviews including determination of significance.
- BAAQMD air permitting projects, including Emergency Diesel Standby Generators, Abatement Equipment, Volatile Organic Compounds, source evaluations, annual updates and Full Facility Build-Out Projects.
- Industrial Waste Water Discharge Permitting projects completed in the jurisdictions of Union Sanitary District, San Jose/Santa Clara Water Pollution Control Plant District.
- Site evaluations for Storm Water Pollution Prevention including determination of status, site assessments, development of Storm Water Pollution Prevention Plans and Storm Water Monitoring Plans, development of best management practices, Notice of intent completion and submittal, and sample collection.
- Site evaluations for Spill Prevention Countermeasures and Control Plans as required by 40 CFR part 112 including applicability determination, site assessment, SPCC plan development and development of associated training.
- Hazardous waste management projects including EPA ID number applications, waste determinations, collection strategies, DTSC questionnaires, biennial

reporting, Hazardous Waste Management Program development and generator status determination.

- Permit by rule applications for various categories of waste treatment.
- Hazardous Materials management including inventories and chemical classifications, hazardous materials business plan development and submittal, chemical storage and containment strategies, training, etc.
- Toxic Release Inventory support including threshold trigger determination, mass balance and report preparation.

Applied Materials, Inc., Santa Clara, CA

Environmental Compliance Manager October 2003 to July 2004 Responsible for maintaining and improving all environmental compliance associated with three semiconductor research and development buildings.

- Maintained compliance via internal inspections and audits, permitting, reporting, reviewing and approving designs, and maintaining logs/records.
- BAAQMD record keeping, permitting, program maintenance, inspections and abatement system review and approval.
- Hazardous Materials Management including HMBP creation, tracking, reporting and inspections.
- Permit By Rule treatment systems, POTW annual self-monitoring report and waste stream analysis.
- Stormwater Pollution Prevention Plans including inspections, sampling and reporting.
- Spill Prevention and Countermeasures Control Plan including annual review and updates for added hazardous.
- Design review for new construction associate with tool installs. Integral part of tool install process from design review and approval to final start-up sign off.
- Site inspections for all environmental requirements.
- Decontamination approvals to verify conformance to requirements prior to disposal and/or shipment.
- Participated in company team to create, update and manage programs for all environmental requirements associated with the company's operations.

Environmental and Occupational Risk Management, Inc., Sunnyvale, CA

Environmental Specialist February 2002 to October 2003 Provided onsite environmental support to a semiconductor client during a full-time outsource position.

- Provided day-to-day support for various environmental requirements including permitting, inspections, hazardous materials/waste management, decontamination approval, and many more.
- Supported facility closure activities including the closure of two conditionally authorized waste treatment systems.

- Supported team activities to reduce notices of violations and/or corrections. Reduced violations and corrections to zero by implementing strategies set by the team.

Applied Materials, Inc., Santa Clara, CA

EHS Intern September 2000 to January 2002 Explored the EHS profession by completing projects based on internal demand. Typical projects included researching regulations, reviewing internal programs, and preparing gap analysis reports to identify internal needs.

- Programs reviewed included Lockout/Tagout, Hazard Communication, Chemical Management, SB14 Waste Reduction Program and Stormwater Pollution Prevention Plan.
- Maintained chemical inventory, Hazardous Materials Business Plan, Stormwater inspections, monthly newsletter, and POTW Self-monitoring report.

City of San Jose/SJSU, San Jose, CA

Internship October 1999 to October 2000

Directed at establishing baseline data for the City of San Jose's compliance with AB939, a waste reduction bill. Duties included collection, collating, analyzing and reporting data.

- Contacted local business to set up meetings for waste stream discussions.
- Gathered all required information for analysis and created reports to show baseline data regarding individual companies.
- Collated information and recommended possible solutions to businesses for waste stream reduction.



Steven R. Trammell, P.E., CSP, CCPSC, CHMM

Principal Consultant

Summary of Experience

Mr. Trammell has over 30 years of experience in a wide range of environmental, health, and safety (EHS) program and project activities, spanning the aerospace, petrochemical, and semiconductor industries. His core competencies include technical risk assessments, process safety management, explosives safety and construction safety, in addition to expertise in regulatory compliance program development, compliance auditing, technical training, and standards development.

He has developed corporate risk assessment programs for multiple companies, and has lead international audit teams to ensure site legal compliance to country specific and international EHS regulations. Mr. Trammell has conducted and led process safety hazards analysis studies for highly hazardous operations and developed programs to comply with OSHA's PSM and the EPA's RMP regulations. He has extensive experience in conducting Job Hazards Analysis (JHA) activities and leading investigation/root cause analysis teams.

Mr. Trammell has provided onsite technical support and EHS program development for new construction and site demolition activities, including start-up support for four

semiconductor manufacturing facilities, two petrochemical processing facilities, three rocket motor fabrication facilities, and decommissioning oversight for a major explosives manufacturing plant.

Professional Certifications and Memberships

Cert. #91612 Registered Professional Engineer, Texas

Cert. #9246 Certified Safety Professional, Systems Safety Cert. #2017075329070868 Certified Process Safety Professional Cert. #4769 Certified Hazardous Materials Manager ISO 45001 Certified Lead Auditor

Education

Bachelor of Science, Mechanical Engineering University of Texas at Austin Master of Business Administration University of Phoenix

Professional Experience

BSI EHS Services and Solutions

Principal Consultant January 2015 to Present Mr. Trammell is a Principal Consultant within BSI. He has a diverse set of EHS skills and direct multinational experience in the petrochemical, electronics, aerospace, pharmaceutical, medical device, and explosives industries. Steve has specialized expertise in risk assessment and risk management program development, including regulatory compliance and supply chain risk management program evaluations and audits. He has led hazards analysis teams performing risk and regulatory-based assessments, using HazOp, LOPA, FMEA, Fault Tree Analysis, and numerous other assessment methodologies.

Steve is an ISO 45001 Certified Lead Auditor and has provided consulting support and performed gap analyses for high technology, pharmaceutical, and chemical-processing industries.

SEMATECH – Austin TX & Albany, NY

Project Manager May 2008 to January 2015 Developed and managed a wide variety of ESH related projects based on SEMATECH member company priorities. Led international project teams and working groups to drive technically-based solutions which ultimately

improved efficiencies of semiconductor processes, ensured compliance to emerging regulations, and established sustainability goals for the industry.

Key projects included:

- Developed ESH protocols for R&D operations involving advanced processing materials for next generation semiconductor devices, with specific focus on the III-V family of materials. Evaluations included personnel exposure assessments, equipment contamination studies, and process safety risk assessments. Led a project initiative, in collaboration with IMEC in Europe, to study III-V outgassing for various processes and chemistries, and developed risk mitigation protocols for personnel and equipment.
- Conducted hazards analysis studies on various processes using energetic materials. Studies included assessments of pyrophoric liquid and gas delivery systems, hazardous by-product formation, development of equipment operating, and maintenance procedures specific to energetic materials and byproducts.
- Evaluated ESH impacts of chemicals in semiconductor effluent streams, which included the effects of fluorine, copper, biocides, and chelators and various nano-materials on standard wastewater treatment processes.
- Evaluated the financial and resource impacts on the industry resulting from proposed regulations, which included the EPA Greenhouse Gas Mandatory Reporting Rule, the European Union REACH regulation, and various emerging global regulations impacting important semiconductor chemistries.
- Initiated risk-based, strategic project activities to evaluate various impact scenarios for the industry. These included carbon footprint modeling, offsite impact modeling for energetic event scenarios, determination of overall site risk using enterprise risk management concepts, and evaluation of equipment readiness using ESH and reliability-based assessment methods.
- Provided site safety support for new facility construction, and installation of manufacturing equipment.
- Conducted an onsite failure modes and effects analysis (FMEA) for Space Shuttle rocket booster processing operations at Vandenberg Air Force Base and provided recommendations to Air Force and NASA safety review boards.
- Developed a remote electrostatic energy measuring instrument system and conducted tests to validate the system. This was the first successful field demonstration of a remote sensing system in the industry.
- Conducted detailed blast, thermal, and fragmentation analysis for rocket motor processing and laboratory operations. Established safe standoff distances for remote operations and designed shielding systems to mitigate operator exposures.
- Conducted industrial hygiene exposure assessments for operations involving isocyanates, beryllium, lead compounds, and various cleaning solvents.

Phillips Petroleum Company – Woods Cross, UT & Bartlesville, OK

Mechanical Design Engineer July 1981 to March 1984 Responsible for preparing mechanical design packages for petrochemical facility expansions. Provided on site design engineering support during multiple plant construction projects and startups, and

conducted physical reviews to validate installations. Developed a design hazards review technique which was eventually established as a corporate standard, and became the basis for the company's Process Safety Management program. Emergency response leader at the Phillips Woods Cross refinery, responsible for training and managing the site's emergency response team and fire brigade.

Additional project work:

- Process Safety Management assessment of facilities manufacturing carbon-based braking systems for commercial, military, and aerospace aircraft. Reviews included assessment of hydrogen delivery systems, chemical vapor deposition process, life safety systems, bulk chemical siting, and waste disposal systems.
- Onsite support of a major demolition and decontamination project on a former rocket motor manufacturing site. Prepared a complete EHS protection program for the site, including hazards analysis of demolition plans, evaluation of site regulatory compliance and training programs, and development and evaluation of environmental Best Known Methods protection systems in support of the Spill Prevention Control and Countermeasure (SPCC) plan.
- Developed corporate and site work instructions for highly hazardous materials processes for a major aerospace company. Work instructions and best known methods documentation included processes involving liquid and solid explosive materials, hydrogen fluoride, ammonium nitrate, anhydrous ammonia, and a variety of other hazardous bulk liquid and gas systems.
- Prepared a corporate risk assessment protocol for a Fortune 100 company, for evaluation and determination of processes requiring formal hazards analysis studies (HazOp, Level of Protection Analysis) and Job Safety Analysis. Conducted trainings sessions for company EHS staff on various hazards analysis and job safety analysis techniques.

Selected Publication and Presentations

- "Operational Excellence Roundtable – Risk Based Process Safety" 2019 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, May 1, 2019.
- "Crash Course on Risk Assessment for Semiconductor Industry, Metal Organics, and Nanoparticles – Professional Development Course", 2018 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, April 29, 2019. (with Andrey Korchevskiy and Daniel Hall – C&IH).
- "Area Gas Detection Placement Optimization using Computational Fluid Dynamic Modeling", 2018 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, April 17, 2018.
- "Accident/Incident Investigations – Data Gathering / Evidence Gathering" Professional Development Course, 2017 / 2018 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, April 21, 2017 (with Sue Creighton-Apple).

- “Effective Application of Risk Controls from Integrated Process Hazards Analysis Evaluations”, 2017 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, April 19, 2017.
- “High Hazard Chemical Installation Case Study”, 2015 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, May 4, 2016 (with Sue Creighton-Apple and Matt Wyman-KFPI).
- “Effective Implementation of EHS Management Systems for Managing Risk Across Diverse Operations”, 2015 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, May 5, 2015.
- “New Materials Introductions for Next Generation Semiconductor Manufacturing, ESH Challenges”, 2014 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, May 8, 2014.
- “Environmental, Safety and Health Aspects of R&D and Manufacturing with Advanced Processing Materials – Best Known Methods and Standardization”, 2014 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, May 7, 2014 (with Andrew McIntyre-BSI).
- “International EHS Management Systems and Compliance Auditing Protocols – Development, Application and Challenges”, 2007 Semiconductor Environmental Safety and Health Association (SESHA) conference, Santa Clara, CA, April 12, 2007.
- Co-author of EHS chapter in “Semiconductor Manufacturing Handbook” Environmental, Safety and Health (ESH) Considerations in Semiconductor Fabrication Facilities, 2005, McGraw-Hill Companies.
- “Techniques for Cost Effective Risk Reduction”, 2004 Semiconductor Environmental Safety and Health Association (SESHA) conference, Scottsdale, AZ, April 15, 2004 and presented at the American Society of Safety Engineers (ASSE) Region III conference, San Antonio, TX,
- August 2, 2004.
- “Integrated Hazards Analysis: Using the Strengths of Multiple Methods to Maximize Effectiveness”, Proceedings for the 2003 ASSE Professional Development Conference, Denver, CO,
- June 23, 2003 (with Donald K. Lorenzo-ABS Group and Brett J. Davis-Motorola).
- “Using a Hybrid HazOp/FMEA Methodology for Evaluation of Fire Risk Scenarios”, Proceedings for the Society of Fire Protection Engineers International Conference, New Orleans, LA, December 2002.
- “Using a Modified HazOp/FMEA Methodology for Managing Process Risk: Semiconductor Environmental Safety and Health Association Journal, Spring 2002 (with Brett J. Davis-Motorola).

- “Fault Tree Analysis, Methodology Overview with Examples,” Presented at the IEEE Photovoltaic Specialists Conference, New Orleans, LA, May 20, 2002.
- “Modified HazOp/FMEA Methodology Overview” Presented at the IEEE Photovoltaic Specialists Conference, New Orleans, LA, May 20, 2002.
- “Using a Modified HazOp/FMEA Methodology for Assessing System Risk,” *IEEE Proceedings for 2nd International Workshop on Engineering Management for Applied Technology*, August 2000 (with Brett J. Davis-Motorola).
- “Evaluation of System Design Using Risk Assessment”, *American Society of Safety Engineers, Professional Development Conference*, Orlando, FL, June 2000 & *Semiconductor Safety Association Conference*, Washington, D.C., April 2000.
- “Integrating Risk Assessment into Management Systems”, *24th Annual International Electronics Manufacturing Symposium*, Austin, TX, August 1999.
- “Bulk Silane Delivery, System Safety Evaluation and Testing Program”, *Proceedings for the 16th International System Safety Conference*, Seattle, WA, September 1998 (with Nasar Chowdhury-APCI).
- “Managing Contractor Safety at Complex Multi-Employer Worksites”, *Semiconductor Safety Association Journal*, Vol. 12, Fall 1998.
- “Risk Analysis and Accident Investigation”, *American Society of Safety Engineers Conference*, Dallas, TX, October 1998.
- “Wet Bench Fire Protection Update and Compliance Strategies”, Presented at the Semiconductor Safety Association Hill Country Chapter Conference, December 1997.
- “Managing HazOps in Semiconductor Processes”, *Semiconductor Safety Association Conference*, Austin, TX, June 1994.
- “Validation of Electrostatic Energy Computer Modeling Techniques in Solid Propellant Processing Operations”, *Joint Army-Navy-NASA-Air Force annual conference*, San Antonio, TX, February 1991.
- “Techniques for Remote Electrostatic Sensing in Solid Propellant Operations”, *Joint Army-Navy-NASA-Air Force annual conference*, San Antonio, TX, February 1989 (with Thomas-Cessario-Thiokol Corp).