Nevada National Security Site

Accident Investigation Board Report

Chemical Explosion at the Nonproliferation Test and Evaluation Complex (NPTEC) on June 13, 2014

U.S. Department of Energy,
National Nuclear Security Administration
Nevada Field Office

National Security Technologies, LLC

August 2014

Disclaimer

This report is an independent product of the Accident Investigation Board appointed by Raymond J. Juzaitis, President, National Security Technologies, LLC (NSTec), and Steven J. Lawrence, Manager, National Nuclear Security Administration Nevada Field Office (NNSA/NFO). The Board was appointed to perform an Accident Investigation and to prepare an investigation report utilizing the guidance provided in U.S. Department of Energy Handbook DOE-HDBK-1208-2012, "Accident and Operational Safety Analysis," Volume I, "Accident Analysis Techniques."

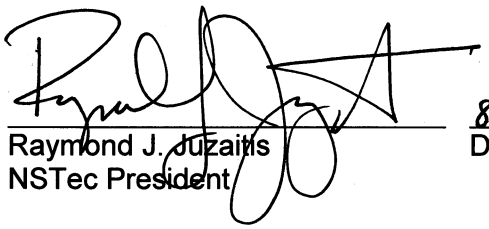
The discussion of the facts as determined by the Board and the views expressed in the report do not assume and are not intended to establish the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

Release Authorization

On June 16, 2014, an Accident Investigation Board was appointed to investigate the drum explosion that occurred on June 13, 2014, at the Nonproliferation Test and Evaluation Complex (NPTEC) facility, located at the Nevada National Security Site (NNSS). The Board's responsibilities have been completed with respect to this investigation. The analysis and identification of contributing causes, root causes, and judgments of need resulting from this investigation followed the guidance provided in DOE-HDBK-1208-2012.

The report of the Accident Investigation Board has been accepted and the authorization to release this report for general distribution has been granted.



Raymond J. Juzaitis
NSTec President

8/8/14
Date

Steven J. Lawrence
NNSA/NFO Manager

8.5.14
Date

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ES.1 Summary

At approximately 0850 Pacific Daylight Savings Time on Friday, June 13, 2014, a 55-gallon drum, believed by workers to be empty, exploded and resulted in non-life-threatening injuries to two personnel. The event occurred at the Nonproliferation Test and Evaluation Complex (NPTEC) at the Nevada National Security Site (NNSS), which operates under the oversight of the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Field Office (NNSA/NFO).

NPTEC, operated under a Management and Operating (M&O) contract by National Security Technologies, LLC (NSTec), is the world's largest facility for open air testing of hazardous toxic materials and biological simulants. It is located at the NNSS on Frenchman Flat, a natural geological basin approximately 75 miles northwest of Las Vegas. The topography, wind predictability, and location provide a secure, controlled environment for small- and large-scale testing.

Opened in 1986 at a cost of $7.6 million, the facility provides independent field testing and evaluation of emerging sensor technologies. In addition, NPTEC can perform tests, experiments, or training for any technology that requires the release of toxic chemicals or biological simulants into the environment. The size of the NNSS and the federally controlled lands surrounding the site provide a large safety zone for public protection.

NPTEC is equipped to test a variety of multiple release sources, including large-scale chemical releases, wind tunnel releases, elevated stack chemical releases, and portable release systems. In addition, NPTEC provides sensor arrays for ground truth data, an explosives pad, weather data instrumentation, calibrated release systems, and 24-hour release capability. NPTEC also maintains the capability to host light aircraft operations on an area lake bed. Elevated stacks and spill pads are available to simulate realistic industrial release and accident scenarios, and test cell areas provide a method to expose materials and instrumentation to high concentrations of test materials in a confined space.

On the morning of June 13, 2014, two NPTEC personnel entered an outdoor chemical storage area (Bay 30) of Building 05-T00014 (known as the West Motel) with the intention of obtaining isopropyl alcohol (IPA) for use in a Work for Others (WFO) project. This activity required accessing a 55-gallon drum containing IPA by moving a second 55-gallon drum that had been emptied of IPA two days earlier on June 11, 2014.

The empty drum exploded immediately upon being moved, resulting in one worker receiving shrapnel lacerations to his lower right leg and foot. He also received contusions, minor burns to his face and arms, and some of the hair on his head, eyebrows, and both arms was singed by the heat flash. The second employee, standing approximately 6 to 8 feet away from the drum, suffered ringing in the ears, but was otherwise not injured by the explosion. In addition, shrapnel from the explosion punctured the rear passenger tire on a nearby utility truck and caused other superficial damage to the passenger side of the vehicle.

The circumstances of this event did not meet the threshold criteria in DOE Order DOE O 225.1B, "Accident Investigations," which would have resulted in the formation of a DOE or NNSA Accident Investigation Board. NSTec and NNSA/NFO Senior Management, however, recognized the significance of the event and began preparations to field a local Accident Investigation Board (Board) using the guidance provided in DOE Handbook DOE-HDBK-1208-2012, "Accident and Operational Safety Analysis."

On June 17, 2014, a joint Board, composed of NSTec, NNSA/NFO, NNSA NA-1, and Sandia National Laboratories personnel began the investigation, based upon prior verbal direction from the Deputy Director of NSTec Global Security (GS). The formal letter appointing the Board, delayed by more pressing concerns associated with event recovery, was issued on July 25, 2014. The Board completed the investigation on July 23, 2014, and submitted the report to Raymond J. Juzaitis, NSTec President, and Steven J. Lawrence, NNSA/NFO Manager, the week of August 4, 2014.

This report addresses the Board's conclusions regarding the causes of the explosion. Based upon the evidence gathered in this accident investigation, the Board concluded that the explosion was wholly preventable and that the development and effective implementation of a comprehensive company-level Chemical Safety and Lifecycle Management (CSLM) Program and a robust facility-specific Chemical Hygiene Plan (CHP) would have prevented the event.

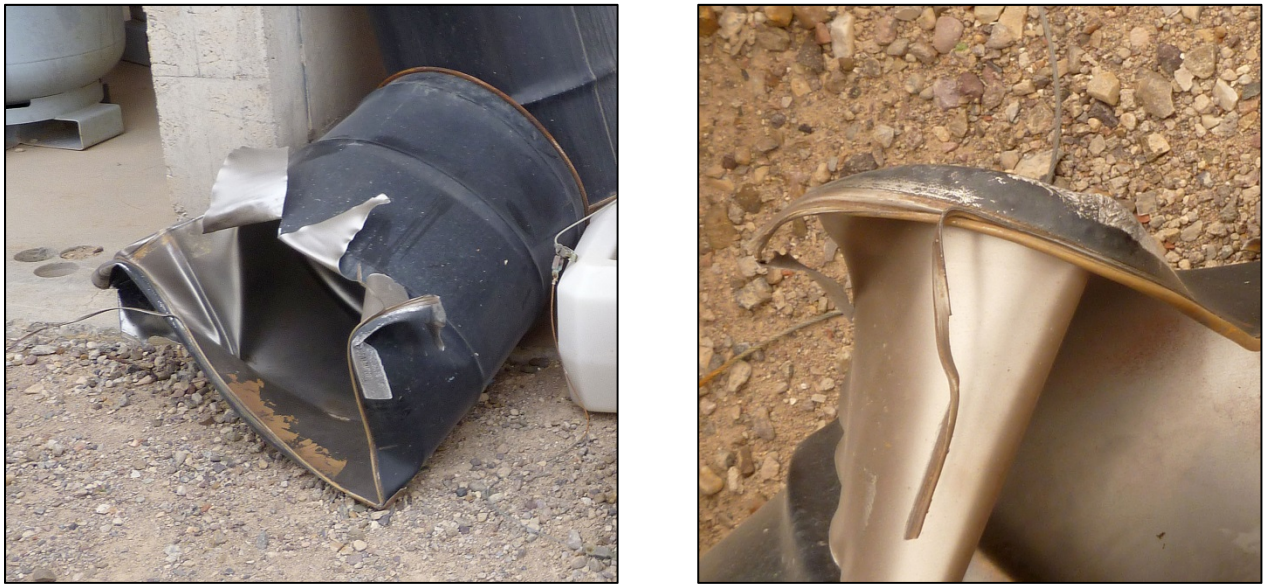
Routine NPTEC operations included procurement, storage, and use of various chemicals, including large quantities of IPA, for WFO projects. The procurements for these projects frequently involved greater quantities of chemicals than strictly required for the test series in order to have a contingency supply in the event that testing beyond the initial test parameters was mandated by environmental or equipment conditions.

Chemicals were frequently retained in anticipation of a WFO customer's return at a future date or for possible use with other potential WFO customer test programs. In those cases where a WFO customer did not return, or the chemical was not used by another customer, this practice resulted in the accumulation of various legacy chemicals. At the time of the event in question, this practice had resulted in the accumulation in Bay 30 of the West Motel of approximately 250 gallons of IPA stored in a mix of open- and closed-top 55-gallon drums, some of which appear to have been received in 2004. In a similar manner, other chemicals of unknown origin or acquisition date had also accumulated in Bay 30, including an unauthorized 55-gallon drum of hydrochloric acid.

There is an extremely high probability that the occurrence of a high-velocity energetic detonation (i.e., explosion) following a weak initiation shock (i.e., movement) in the drum originally containing pure IPA was the result of the accumulation of organic peroxide compounds in the drum. Peroxide bonds form in IPA as the result of a slow oxidation reaction with atmospheric oxygen that proceeds by a free-radical chain mechanism. IPA and other secondary alcohols are favored in this reaction by the enhanced stability of the free-radical precursor. Peroxide formation is accelerated by heat, light, exposure to ionizing radiation, and any other environmental condition that increases the rate of free-radical formation in the solvent. This reaction is normally observed only in the pure solvent. In concentrated form, organic peroxides are exceptionally prone to explosive decomposition and very sensitive to initiation by mechanical shock, friction, or heat.

The known peroxide-forming compounds are categorized into three groups based on their tendency to generate hazardous concentrations of peroxide under normal storage conditions. IPA and the other secondary alcohols are categorized as Group B peroxide-forming compounds. These solvents form peroxides that subsequently undergo a slow decomposition reaction under normal storage conditions. As a result, peroxide accumulation in this group is limited to a maximum equilibrium concentration where the rate of peroxide formation is equal to the decomposition rate. This equilibrium concentration is typically well below the explosive threshold concentration. Peroxide concentrations in Group B compounds usually reach hazardous levels only after the peroxides are concentrated by evaporation. Commonly, the peroxidized form is always less volatile than the parent compound, and will be preferentially left behind, increasing to dangerous concentration levels as the parent compound evaporates.

The handling and storage conditions experienced by the drum that exploded were very conducive to peroxide formation. This drum, one of seven located at this site, had been in storage for an indeterminate period, with estimates ranging from 7 to 10 years. The storage location over this period was subjected to extreme heat during the summer months, reaching temperatures in the range of 120°F. The drum lid had been left off for two days prior to the event, allowing some portion of remaining IPA in the drum to evaporate. Temperatures during this evaporation period exceeded 100°F for most of the daylight hours, peaking near 110°F. The interior of the drum was also exposed to direct sunlight for a portion of this evaporation time.



NOTE: The left image shows the bottom of the exploded drum. The right image is a close-up view of the bottom seam of the drum.

Figure ES-1. Views of Exploded Drum

The blast damage to the bottom of the drum is shown in the left image of Figure ES-1. The bottom of the drum was completely separated from the walls. The metal was ripped and peeled back on only one side of the drum, indicating that the explosion was anti-symmetric. The close-up view of a remnant of the bottom seam of the drum shows that the folded seam was “unzipped” by the explosion. The metal deformation observed on the bottom of the drum indicates that the explosion generated a high-velocity shock wave characteristic of a unimolecular detonation. A fuel-air explosion would result in less metal deformation and a much slower shock wave, with most of the energy being dissipated through the open top of the drum.

Two other causes for the explosion were examined and ultimately rejected by the Board:

- Initial reports during accident recovery indicated that a small amount of residual IPA in the drum may have ignited, which resulted in an overpressure condition and rupture. This was based on initial information provided by the NPTEC Local Emergency Director (LED) to the Operations Command Center (OCC), as well as to NNSS Fire and Rescue (F&R) personnel. As described above, however, a fuel-air explosion would have dissipated its energy more slowly, with most of the energy exiting through the open top of the drum.

- Contamination of the IPA with another explosive compound (not naturally formed during storage) during some prior use was also considered. However, the NPTEC facility has not kept sufficient records to either positively confirm or eliminate this possibility. Therefore, there is no evidence to support contamination as a viable cause in this case.

The development and effective implementation of both a comprehensive company-level CSLM Program and a robust facility-specific CHP would have prevented the event from occurring. An effective chemical management program consists of a "cradle to grave" methodology whereby the overall process is a cycle of interrelated elements, addressed in terms of the hazards posed by chemical usage. The process begins during the planning of work prior to acquisition and continues through the final disposal of the chemical. The Board determined that NSTec failed to implement the following basic elements of a CSLM Program:

- Chemical tracking and inventory commencing upon chemical receipt
- Chemical ownership assignment
- Accountability for tracking and proper storage
- Routine inspections for condition, labeling, and inventory
- Maintenance of current Material Data Safety Sheet (MSDS)
- Chemical purchase minimization
- Clear disposition paths when chemicals are no longer needed or have exceed their shelf life

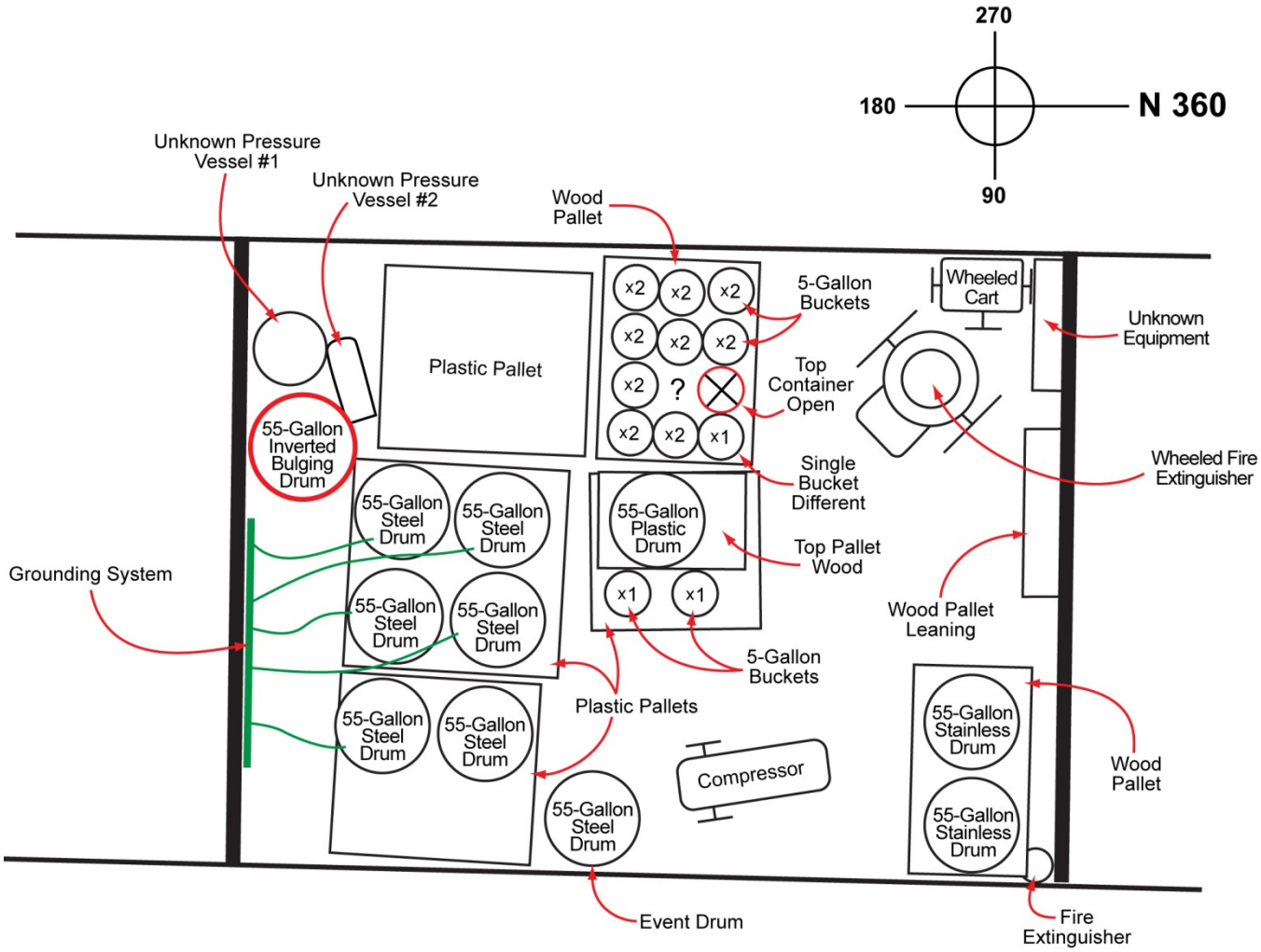
The Board also determined that NSTec self-assessment and NNSA/NFO oversight weaknesses, and/or inconsistent implementation, contributed to legacy chemicals being inappropriately stored at NPTEC. In addition, the Board determined that prior attempts to have these same legacy chemicals appropriately dispositioned were not successful due to perceived lack of funding, combined with the ability of facility management to render such decisions without Senior Management participation in the process. Self-assessment, federal oversight, and issues management are more thoroughly discussed in Sections 12.0, 8.0, and 9.0, respectively.

ES.2 Accident Description

On Wednesday, June 11, 2014 (two days before the event), an NPTEC project representative and an NPTEC subcontractor went to the NPTEC West Motel Bay 30 (an area used for chemical storage) to extract IPA from a 55-gallon drum (hereafter referred to as the event drum). The workers removed the lid from the event drum and pumped the IPA into a transfer container. During the liquid transfer, the workers noted that a coating on the inside surfaces of the event drum was falling off and collecting in the bottom. The workers pumped as much of the IPA from the event drum as possible with the equipment available. At end of the IPA pumping operation, the drum appeared to be empty and the lid was not placed back on the drum, to allow any residual IPA to evaporate. The event drum was left at the front of the east entrance to Bay 30, resting on the concrete, with a grounding cable attached. The workers then left the West Motel site without incident.

On Friday, June 13, 2014, at approximately 0830, three workers began test preparation activities at the NPTEC test area.

At approximately 0845, two workers (also referred to in this report as Worker A and Worker B) left the test bed area and went to Bay 30 of the West Motel to obtain additional IPA. In support of this transfer, the presumably empty event drum located at the East entrance of Bay 30 needed to be moved to allow access to IPA drums located further inside the bay. Figure ES-2 shows the pre-event plot of Bay 30.



Note: Drawing Not to Scale

Figure ES-2. Pre-Event Plot of Bay 30

At approximately 0850, Worker A manually lifted the event drum and it simultaneously exploded. The resulting concussive effect projected Worker A approximately 8 feet out of Bay 30. Worker A received shrapnel lacerations to his lower right leg and foot. Required personal protective equipment (PPE) for work activities included safety shoes, but Worker A was wearing tennis shoes. He also received contusions, minor burns to his face and arms, and some of the hair on his head, eyebrows, and both arms was singed by the heat flash. Worker B, standing further inside Bay 30, approximately 6 to 8 feet away from the drum, suffered ringing in the left ear, but was otherwise not injured by the explosion. He exited Bay 30 to assist Worker A and initiate notifications.

In addition, shrapnel from the explosion punctured the passenger rear tire on a nearby utility truck and caused other superficial damage to the passenger side of the vehicle. Figure ES-3 shows the immediate post-event plot of Bay 30. Figures ES-4 and ES-5 show examples of shrapnel damage to the nearby utility truck.

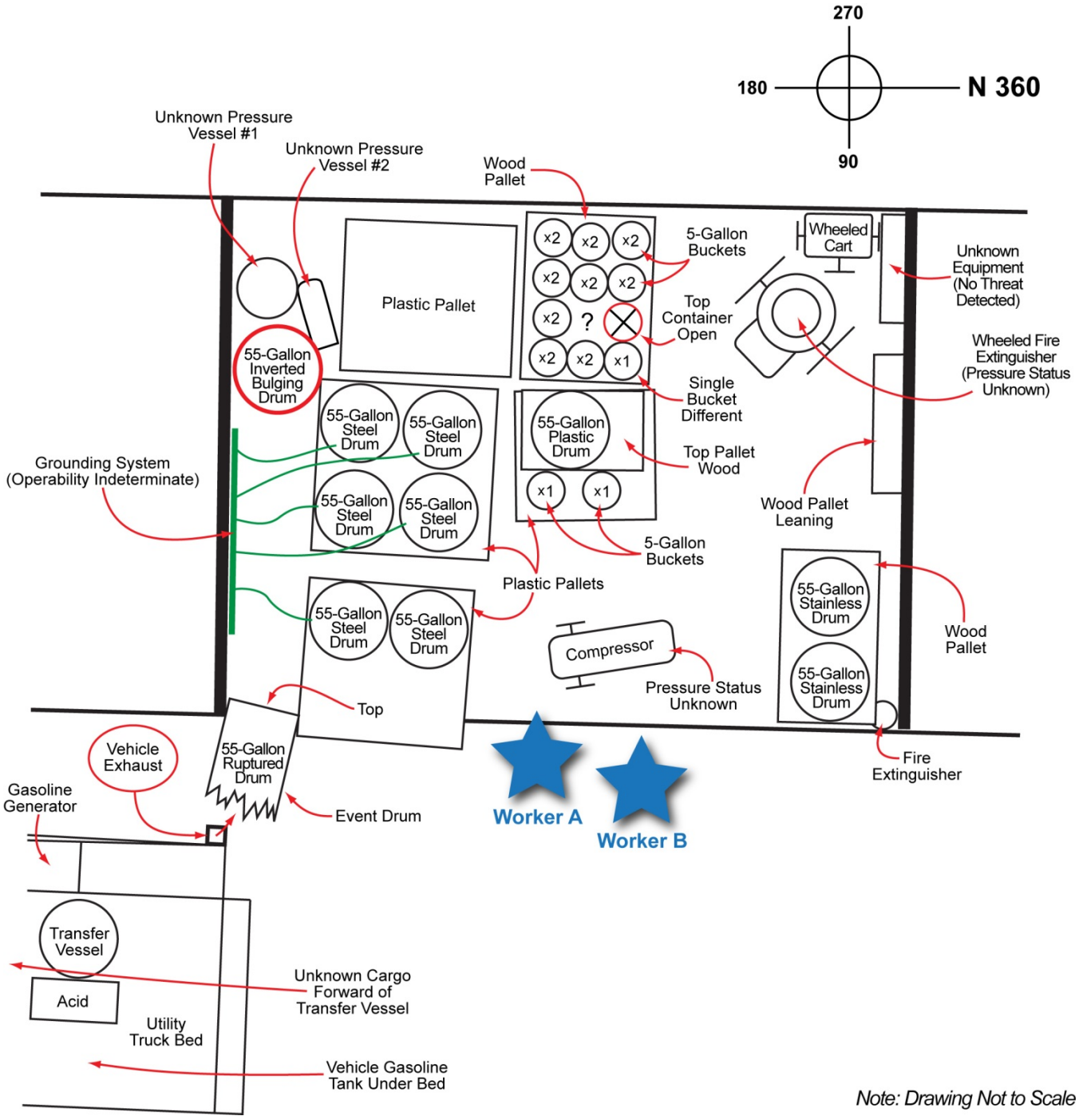


Figure ES-3. Immediate Post-Event Plot of Bay 30

Figure ES-4. Tire Punctured by Shrapnel from Drum Explosion

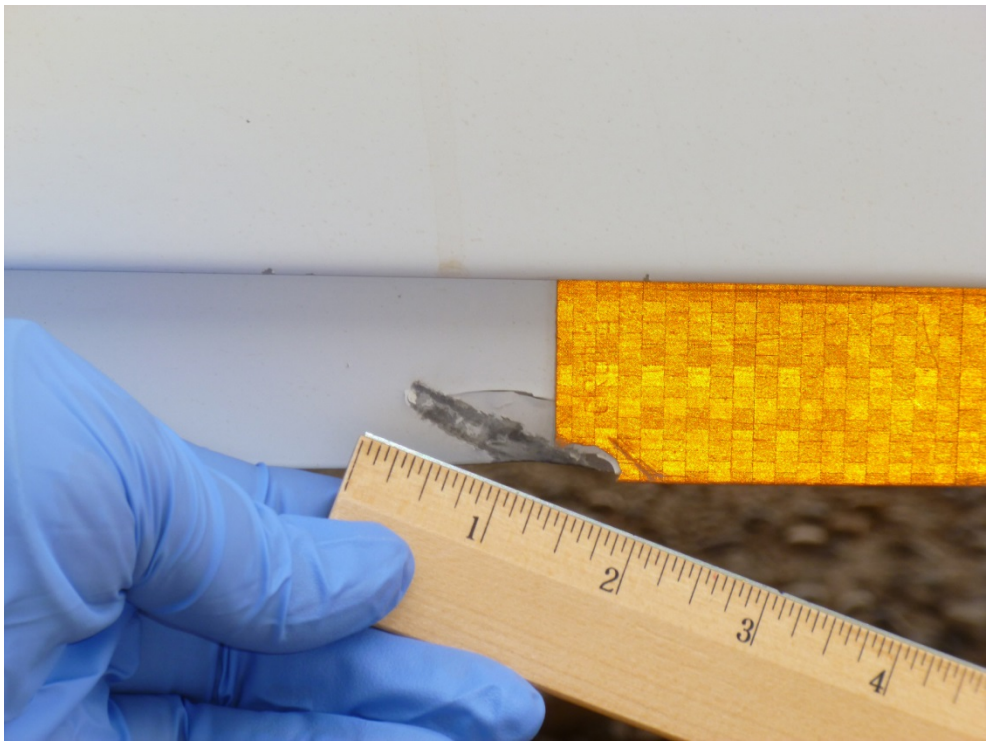


Figure ES-5. Shrapnel Damage to Cab of Nearby Utility Truck

ES.3 Direct, Root, and Contributing Causes

Direct Cause – the immediate events or conditions that caused the accident.

The preponderance of evidence indicates that the direct cause of the event was the detonation of shock-sensitive peroxides caused by movement of the event drum.

Root Cause – causal factors that, if corrected, would prevent recurrence of the same or similar accidents. Root causes may be derived from or encompass several contributing causes. They are higher-order, fundamental causal factors that address classes of deficiencies, rather than single problems or faults.

The Board identified three root causes to the drum explosion event:

1. **The safety culture at NPTEC did not facilitate the effective identification and resolution of problems.** Personnel were reluctant to raise concerns, due in part to lack of effective resolution from previous attempts to address problems. Concerns with bulk storage of aging chemicals were assigned the lowest possible priority, or actions deferred, and challenges regarding bulk storage of legacy chemicals were not elevated to higher levels of management.

2. **NSTec failed to fully implement formality and operational rigor necessary for managing and operating NPTEC.** NPTEC operations were not adequately staffed or managed to ensure effective implementation and control of activities. Limited Nuclear Operations Directorate (NOD) management presence hindered the ability to achieve effective Conduct of Operations (CONOPS) implementation.

3. **NSTec did not effectively manage chemicals in a safe and compliant manner, including the disposition of legacy chemicals.** NSTec does not have a comprehensive company-wide CSLM Program and NPTEC does not have a CHP. The NPTEC West Motel was not authorized for storage of flammable/combustible substances, and chemicals of unknown origin, and/or unknown content, were stored at this location for several years.

Contributing Causes – events or conditions that collectively with other causes increased the likelihood of an accident, but that individually did not cause the accident. Contributing causes may be long-standing conditions or a series of prior events that, alone, were not sufficient to cause the accident, but were necessary for it to occur. Contributing causes are the events and conditions that "set the stage" for the event and, if allowed to persist or recur, increase the probability of future events or accidents.

The Board identified three contributing causes to the drum explosion event:

1. **The transition of NPTEC facility management from GS to NOD created a false sense of security with respect to the formality of facility operations.** NOD management did not provide ongoing feedback to achieve the anticipated increase in operational rigor. NSTec Senior Management was not aware of the adversarial relationship/unhealthy tension between GS and NOD that promoted a culture of indifference related to the storage of legacy chemicals.

2 **NPTEC Facility and Program organizations did not effectively manage issues.** On occasion, responsible managers made non-conservative decisions when addressing issues due to time or resource constraints, resulting in corrective actions that address the immediate problem without consideration of the systemic or programmatic causes.

3 **NSTec and NNSA/NFO processes did not enable risk-informed decision making regarding operation and maintenance of NPTEC.** NPTEC oversight (facility, project, federal) did not fully recognize hazards associated with storing bulk/legacy chemicals in the West Motel. NOD has not established minimum criteria for operation and maintenance of NOD Moderate Hazard Facilities such as NPTEC.

ES.4 Conclusions and Judgments of Need

Based upon the results of this accident investigation, the Board concluded that the explosion of the drum was wholly preventable. While the hazard of IPA peroxide formation was not well known throughout contractor and federal organizations outside of laboratory settings, a comprehensive Chemical Safety and Lifecycle Management Program, properly implemented, would have resulted in controls to limit the storage of the IPA, particularly under the conditions in which they were stored, thereby providing greater confidence that the event would not have occurred.

Table ES-1 summarizes the Conclusions and Judgments of Need determined by the Board. The Conclusions are derived from the analyses performed during this accident investigation to determine what happened and why it happened. The Judgments of Need were determined by the Board as those managerial controls and safety measures necessary to prevent or minimize the probability or severity of a recurrence of this type of accident.

Table ES-1. Conclusions and Judgments of Need

Conclusion (CON)	Judgment of Need (JON)
Authorization Basis	
CON 1: The West Motel was not appropriately analyzed or approved for chemical storage in the NPTEC Real Estate Operations Permit (REOP).	**JON 1:** NSTec needs to ensure that the NPTEC REOP addresses all potential hazards and their locations, including storage of chemicals.
CON 2: The periodic review, update, and approval of NPTEC facility documentation did not identify hazards associated with storage of chemicals at the West Motel.	**JON 2:** NSTec needs to perform an Extent of Condition review of REOPs for other Moderate Hazard Facilities to ensure that all potential hazards are identified and appropriately mitigated.
CON 3: NSTec has not required establishment of comprehensive “authorization basis” documentation, or equivalent, to ensure Moderate Hazard Facilities are operated in a safe and compliant manner.	**JON 3:** NSTec needs to develop comprehensive “authorization basis” documentation, or equivalent, for Moderate Hazard Facilities.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Chemical Safety	
CON 4: NSTec has not developed a corporate-level program to ensure all aspects of chemical safety and lifecycle management are integrated and consistently addressed at the facility level. **CON 5:** NSTec does not have a Chemical Safety Authority Having Jurisdiction (AHJ), or equivalent individual, responsible for enforcing chemical safety requirements. **CON 6:** There were no provisions to confirm at any periodicity that the most recent MSDS (incorporating current chemical hazard information) is available for use at NPTEC. **CON 7:** The NPTEC MSDS Index was not developed or maintained in accordance with the NSTec Hazard Communication (HAZCOM) company directive. **CON 8:** The NPTEC hazardous materials management procedure did not institute adequate procurement controls to minimize chemical-related hazards. **CON 9:** NSTec has not implemented an automated chemical tracking system to provide real-time (dynamic) inventory management of chemicals in all facilities. **CON 10:** No evidence exists in the form of tests or inspections to demonstrate that the minimum functional capabilities of the NPTEC grounding systems were met to ensure safe operations. **CON 11:** The NPTEC West Motel is not an "approved flammable liquid storage room," as required by NSTec Company Directive CD-P280.029, "Flammable/Combustible Liquids and Aerosol Products." **CON 12:** Containers used for storing hazardous chemicals at NPTEC were not labeled as required (i.e., chemical identification and appropriate hazard warnings).	**JON 4:** NSTec needs to establish procurement controls that that enable just-in-time contracts and ensure only the minimum amounts of chemicals needed to perform planned work are ordered. **JON 5:** NSTec needs to consider implementing an effective hazardous waste management plan. **JON 6:** NSTec needs to consider implementing an automated tracking system that will enable real-time (dynamic) inventory management of chemicals in all facilities. **JON 7:** NSTec needs to consider establishment of a single "corporate approved" MSDS for all chemicals, including a mandatory review periodicity (e.g., annually). **JON 8:** NSTec needs to examine options to enhance performance of Health Hazard Evaluations (HHEs). **JON 9:** NSTec needs to consider implementing a comprehensive CSLM Program that ensures all aspects of chemical safety and management are integrated and consistently addressed at the facility level. **JON 10:** NSTec needs to consider development and implementation of CHPs for selected facilities, including NPTEC. **JON 11:** NPTEC needs to ensure chemicals are appropriately stored in accordance with governing NSTec requirements and MSDS criteria.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Chemical Safety (continued)	
CON 13: Incompatible chemicals were not stored separately as required to prevent contact in the event of an accident. **CON 14:** HHEs performed at NPTEC did not appropriately categorize the facility and did not identify improper storage of chemicals. **CON 15:** NPTEC has not implemented a documented process that identifies, in a timely manner, excess chemicals and appropriate protocols for reuse, recycle, or disposal. **CON 16:** NSTec has not developed a CHP for NPTEC.	
Conduct of Operations	
CON 17: The Board determined that while the NPTEC CONOPS program is well defined in the associated CONOPS Implementation Matrix, it has not been effectively implemented. **CON 18:** Staffing plans were not produced and technical support line management was unable to state what was considered "minimum staffing" for safe operations. **CON 19:** Configuration Management has not been formally assessed by NSTec for non-nuclear facilities. **CON 20:** Impact of out-of-service cameras was not recognized. **CON 21:** Logkeeping and turnover of duties and responsibilities are not being conducted in accordance with company requirements. **CON 22:** Facility-level procedures do not accurately reflect currently approved company directives. **CON 23:** GS and NOD management promoted the concept of "Formality in the Workplace," in lieu of "Conduct of Operations," thereby diluting the importance of a long-standing overall philosophy for achieving excellence in the operation of DOE facilities.	**JON 12:** NSTec needs to ensure that a comprehensive CONOPS program is effectively implemented for all NPTEC activities in a tailored manner versus attempting to implement a Formality of Operations process. **JON 13:** NSTec needs to ensure that facility equipment required to support project activities (e.g., cameras) is effectively maintained whereby it can perform its intended function. **JON 14:** NSTec needs to conduct an Extent of Condition review of other NSTec facilities implementing the DOE CONOPS program.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Emergency Management	
CON 24: NPTEC emergency planning documents do not clearly identify those hazardous materials that, while screened out from further analysis in the Emergency Planning Hazards Assessment (EPHA), may be considered initiators or promoters of a release of other toxic substances. **CON 25:** The LED and Duty Manager decision-making process for the event categorization/ classification process was not consistent with their respective processes and training. **CON 26:** The transfer of the 9-1-1 call from the Nye County Dispatcher to the OCC Fire Dispatcher was not consistent with the verbal agreement and expectations of the OCC Department Manager. **CON 27:** The notification to the onsite Nye County Sheriff's Deputy by the WSI-Nevada Central Alarm System (CAS) was not consistent with the Nye County Sheriff's Mercury Sub-Station Lieutenant's expectation of timeliness. **CON 28:** The OCC Fire Dispatch Centracom link to the F&R Fire Station Public Address link did not operate as designed. **CON 29:** The LED's initial assessment of the scene was not completely accurate, nor did he recognize the potential hazards remaining at the scene. Information provided by the LED to the OCC Duty Manager, Fire Dispatcher, and responders downplayed the actual incident conditions. **CON 30 (POS):** F&R personnel continued scene assessment after arriving at the West Motel and, recognizing that there were still potential hazards, evacuated all personnel to a safe location.	**JON 15:** NSTec needs to evaluate its current screening process for identification of those hazardous substances that, while screened out from analysis in an EPHA, may be considered initiators or promoters of a release of those toxic substances analyzed in the EPHA. **JON 16:** NSTec needs to evaluate its current process for documenting those hazardous substances that, while screened out from further analysis in the EPHA, may be considered initiators or promoters of a release of other toxic substances analyzed in the EPHA. **JON 17:** NSTec needs to evaluate its categorization/classification process and training to ensure that personnel with categorization/ classification decision-making responsibilities are following their respective processes and training. **JON 18:** NSTec needs to evaluate establishing a more formal agreement with the Nye County Sheriff's Office to capture expectations for transferring NNSS-specific 9-1-1 call information. **JON 19:** Nye County Sheriff's and WSI-Nevada's leadership need to evaluate current documentation (if any) requiring timely notification to Sheriff's Deputies by the CAS. **JON 20:** NSTec Information Technology needs to evaluate the effectiveness of the Centracom to Public Address link in the OCC and Fire Stations 1 and 2. **JON 21:** NSTec needs to evaluate whether current LED training is adequate to properly perform incident size-up, event recognition, and relay of critical incident information in a factual manner to emergency services personnel.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Emergency Management (continued)	
CON 31: Although an inventory of chemicals housed in the West Motel structure was available, it was from March 2014 and the LED gave the impression that he could not confirm current inventory status. This deteriorated trust between the Incident Commander and facility subject matter experts (SMEs).	**JON 22:** F&R personnel need to be recognized for having a questioning attitude and evacuating all personnel out of the hazard area based upon remaining potential hazards. **JON 23:** NSTec needs to evaluate the current method of configuration management in regards to chemical inventory, storage, compatibility, and use at the NPTEC Facility.
Environmental Compliance	
CON 32: The NPTEC National Environmental Policy Act (NEPA) documents have not been updated on a routine basis as different projects and use of different chemicals occur. **CON 33:** Evaporation of chemicals in an effort to reduce the volume is considered treatment of a waste under the Resource Conservation and Recovery Act (RCRA) and can only be performed by a permitted Treatment, Storage, or Disposal facility. **CON 34:** Procedures lack specificity regarding definition of an empty drum as well as how non-empty drums should be handled.	**JON 24:** NPTEC needs to ensure that procedures include appropriate handling instructions for drums, as well as clearly defining what constitutes an empty drum. **JON 25:** NSTec needs to ensure that a NEPA document is prepared for each specific test conducted at NPTEC versus use of an overarching NEPA document. **JON 26:** NSTec needs to ensure that company documents clearly indicate what is considered treatment under RCRA to avoid treating wastes without a permit.
Federal Oversight	
CON 35: Current NNSA/NFO collateral duties do not ensure adequate field time at Moderate Hazard Facilities. **CON 36:** Current NNSA/NFO oversight approach does not define performance-based attributes that enable effective transactional oversight. **CON 37:** NNSA/NFO was not aware of the risk associated with legacy chemical storage at NPTEC. **CON 38:** NNSA/NFO oversight placed a high reliance on the Contractor Assurance System, rather than direct observations of contractor performance.	**JON 27:** NNSA/NFO needs to develop and implement an effective performance-based oversight plan for all moderate-hazard activities.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Issues Management	
CON 39: NPTEC management of issues pertaining to activity-level work processes and chemical management have not been effective in reducing repeat findings. **CON 40:** Due to time and resource constraints, Responsible Managers (RMs) on occasion make non-conservative decisions when addressing issues. The result is that the corrective actions address the immediate problem without consideration of the systemic or programmatic causes. **CON 41:** Due to the authority given to the RMs with regards to issues management, Senior Management is missing an opportunity to fully appreciate the non-conservative decisions that personnel are making based upon time and resource constraints and the risk NSTec may inadvertently be assuming.	**JON 28:** NSTec needs to ensure that NPTEC-related issues are evaluated in their totality to identify and address programmatic weaknesses, which may require issues to be re-opened, priorities adjusted, and/or additional action(s) taken. **JON 29:** NSTec Management needs to ensure that the five issues from the Facility Programs and Real Estate Services site assistance assessment (conducted August 30 to October 10, 2012) are placed into the companywide issues tracking system (caWeb) and dispositioned. **JON 30:** NSTec Senior Management needs to examine the disposition authority currently afforded to the RMs when dealing with issues.
Management	
CON 42: NPTEC facilities and processes are not being effectively managed. In addition, the potential hazards, and risks, associated with management of chemicals at NPTEC facilities are not readily understood throughout the NSTec management organization.	**JON 31:** NSTec needs to establish a comprehensive management strategy for NPTEC so that risks are identified, and appropriate abatement strategies are implemented. This strategy would also include a methodology whereby funding for essential facility infrastructure considerations are not dependent on individual customer preferences.
Safety Culture	
CON 43: NNSA/NFO and NSTec have not effectively communicated efforts to address results of the 2013 Safety/Security Culture Assessment (S/SCA) Report. **CON 44:** The transition of NPTEC facility operations to NOD has yet to achieve the anticipated benefits. The lack of Senior Management visibility and consistent facility management presence is counter to maintaining an effective safety culture (e.g., no consistent line management visibility).	**JON 32:** NNSA/NFO and NSTec need to examine options to reengage personnel whereby results of the S/SCA Report are examined, process improvements clearly linked, and successes publicized/celebrated. **JON 33:** NSTec needs to enhance efforts to convey desired behaviors to NPTEC personnel as well as ensuring GS and NOD Senior Management increase their visibility at NPTEC.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Safety Culture (continued)	
CON 45: The NNSA/NFO Mission Area Representative and Facility Representative do not maintain effective internal communications regarding status of NPTEC facilities and associated operations. **CON 46:** In some instances, NPTEC personnel are no longer utilizing caWeb, MAXIMO, and similar processes to identify concerns, issues, or facility repairs. **CON 47:** Routine evaluations of NPTEC facilities and processes are not being consistently performed in accordance with established criteria. **CON 48:** Comprehensive Independent Assessments of NPTEC activities have not been conducted by NSTec (i.e., Quality Assurance Program and Parent Organization Oversight Committee [POOC]).	**JON 34:** NSTec needs to ensure that Moderate Hazard Facilities have a Facility Manager who can maintain focus on safe and compliant operations. **JON 35:** NNSA/NFO needs to examine current methods being utilized to monitor NPTEC operations, including enhancing communications between federal project and oversight personnel. **JON 36:** NSTec needs to reinforce the use of caWeb, MAXIMO, and similar processes to identify issues, concerns, and facility maintenance needs. **JON 37:** NSTec needs to ensure that all NPTEC facilities, and processes, are routinely evaluated in accordance with established criteria, including the use of SMEs as appropriate for these evaluations. **JON 38:** NSTec needs to ensure Independent Assessments of NPTEC facilities and processes are conducted.
Self-Assessment and Corporate Oversight	
CON 49: The POOC has not conducted independent assessments of NPTEC operations or chemical safety in general. **CON 50:** The Quality Assurance and Control Division has not conducted routine Independent Assessments evaluating Moderate Hazard Facilities, including NPTEC. **CON 51:** GS and NOD have not effectively evaluated their project and facility as a whole to evaluate potential programmatic weaknesses, including those across the directorates, at both the project and facility levels. **CON 52:** Fire Safety Assessments (FSAs) for NPTEC are not being conducted in accordance with prescribed schedules.	**JON 39:** NSTec needs to ensure FSAs are performed for NPTEC in accordance with prescribed schedules. **JON 40:** NSTec needs to establish a process whereby POOC representatives, and/or outside SMEs, periodically evaluate performance of Moderate Hazard Facilities, including NPTEC. **JON 41:** NSTec needs to establish a routine cycle for Independent Assessments of Moderate Hazard Facilities. **JON 42:** NSTec needs to ensure GS and NOD periodically assess how effectively they perform their joint responsibilities for NPTEC.

Table ES-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Training and Qualification	
CON 53: Not all NPTEC personnel have ensured required training is being maintained. **CON 54:** NSTec has not ensured that appropriate training has been assigned for NPTEC subcontractor personnel nor ensured that this training has been completed prior to performance of work.	**JON 43:** NSTec needs to ensure appropriate training has been identified, and successfully completed, for all personnel supporting NPTEC operations/activities prior to performance of work.
Work Control	
CON 55: NPTEC activity-level work packages did not address transfer or dispensing of chemicals. This resulted in cascading failures with respect to Integrated Work Control Process (IWCP) elements designed to ensure proper analysis of hazards, development of controls, and performance of work within those controls. **CON 56:** The process used to evaluate proposed revision of the project work package did not include a walk-down or an effective tabletop review whereby all affected parties could be afforded the opportunity to review revisions as a team.	**JON 44:** NSTec needs to ensure IWCP is effectively implemented for all NPTEC program and project activities.

1.0 INTRODUCTION

1.1 Appointment of the Board

On June 16, 2014, an Accident Investigation Board (the Board) was appointed by Raymond J. Juzaitis, President of National Security Technologies, LLC (NSTec), and Steven J. Lawrence, Manager of the National Nuclear Security Administration Nevada Field Office (NNSA/NFO), to investigate the drum explosion that occurred on June 13, 2014, at the Nonproliferation Test and Evaluation (NPTEC) facility located at the Nevada National Security Site (NNSS).

The Board's responsibilities have been completed with respect to this investigation. The analysis and the identification of the contributing causes, root causes, Conclusions (CONs), and Judgments of Need (JONs) resulting from this investigation followed the guidance provided in U.S. Department of Energy (DOE) Handbook DOE-HDBK-1208-2012, "Accident and Operational Safety Analysis."

The circumstances of this accident did not meet the threshold criteria in DOE Order DOE O 225.1B, "Accident Investigations," which would have resulted in the formation of a DOE or NNSA Accident Investigation Board. However, both NSTec and NNSA/NFO Senior Management recognized the significance of the accident and convened a local Board accordingly.

Due to ongoing recovery efforts at the accident scene, including disposition of legacy chemicals, the Board had limited access to the area. To address this challenge, two members of the Board (the NNSS Fire & Rescue [F&R] Chief and Deputy Chief) conducted a comprehensive walk-down of the accident scene. This effort was documented through video and still photography that was shared with the balance of the Board.

The Board began the investigation on June 17, 2014; completed the investigation on July 23, 2014; and submitted findings to the appointing officials the week of August 4, 2014. The Board concluded that this accident was preventable.

1.2 NNSA/NFO Description

The Nevada Field Office (NFO) was established by NNSA to oversee operations at the NNSS and other outlying facilities. Routine activities include the safe and secure conduct of high-hazard operations, testing, and training in support of NNSA, the U.S. Department of Defense, and other federal agencies. It also provides the U.S. Government with the capability to return to underground nuclear testing should the President deem it necessary.

NNSA/NFO provides oversight and local coordination of NNSA Defense Programs activities involving effectiveness of our nuclear deterrent through the Stockpile Stewardship Program. Several major NNSS facilities support that mission, including the Device Assembly Facility (DAF), the U1a underground complex (U1a), the Big Explosives Experimental Facility (BEEF), and the Joint Actinide Shock Physics Experimental Research (JASPER) Facility. The NNSS also provides a remote test location for evaluating sensor technologies, as well as for methods of detecting, characterizing, and monitoring nuclear weapons–related activities that are useful for arms control and nonproliferation purposes.

NNSA/NFO provides management oversight and direct support to NNSA National Nuclear Emergency Response efforts using Nevada-based assets. These include the execution of aerial measurements, consequence management and crisis response, and providing program direction for the receipt,

staging, assessment, disassembly, and/or destruction of nuclear or radiological devices during emergency scenarios.

NNSA/NFO supports other federal agency activities, such as remote imaging, chemical/biological projects, military training, and special projects. NNSA/NFO also oversees the conduct of training for first responders in the prevention, protection, and response to possible terrorist use of radiological or nuclear material as a weapon.

The Environmental Management Program addresses the environmental legacy of historical nuclear weapons–related activities and current programs at the NNSS. NNSA/NFO oversees permanent disposal of low-level and mixed low-level radioactive waste generated by environmental cleanup activities at the NNSS and other DOE and U.S. Department of Defense sites historically involved with nuclear weapons research, development, and testing.

NNSA/NFO is managed and operated by 101 federal staff members, assigned to eight organizational components, including the Office of the Manager and the Offices of Site Operations, National Security, Safety and Security, Environment Management, Business and Contract Management, Public Affairs, and Site Council.

1.3 NSTec Description

In July of 2006, NSTec was awarded the Management and Operating (M&O) Contract for the NNSS. NSTec is a joint venture among Northrop Grumman Corporation, AECOM, CH2M Hill, and Babcock & Wilcox. In addition to the NNSS, NSTec is responsible for facilities located in North Las Vegas, Nevada; Long Island, New York; Los Alamos, New Mexico; Livermore, California; San Diego, California; Santa Barbara, California; and at the Remote Sensing Laboratory (Las Vegas, Nevada, and Andrews Air Force Base, Maryland).

NSTec partners with NNSA/NFO and its customers, including Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory, and Sandia National Laboratories. NSTec also performs work for DOE Headquarters (HQ) Divisions and for other federal agencies, such as the U.S. Department of Defense, including the U.S. Army, U.S. Air Force, and U.S. Navy; the U.S. Department of Homeland Security (DHS); the Defense Threat Reduction Agency; and the Federal Emergency Management Agency.

The NSTec organization is led by a President, a Vice President, and supported by a total of nine directors. There are approximately 2,200 employees, including approximately 24 bargaining units (e.g., unions).

1.4 NNSS Description

The NNSS, located approximately 70 miles north of Las Vegas, Nevada, is an extensive outdoor laboratory and national experimental center larger than the state of Rhode Island. NSTec is responsible for performing an array of activities at the NNSS, including stockpile stewardship, hazardous chemical spill testing, emergency response training, waste management, environmental technology studies, and support for DHS and other federal agencies. At approximately 1,375 square miles, the NNSS is one of the largest restricted access areas in the United States.

The remote site is surrounded by thousands of additional acres of land withdrawn from the public domain for use as a protected wildlife range and for a Nellis Air Force Base military gunnery range, creating an unpopulated land area comprising some 5,470 square miles.

1.5 NPTEC Description

In 1982, the United States House Appropriations Subcommittee on Energy and Water Development proposed funding for a Liquefied Gaseous Fuels Spill Test Facility where tests could be performed on hazardous chemicals and liquefied gaseous fuels. Congress passed Public Law 97-377, which authorized construction. Congress directed DOE to site and manage construction of the facility and to develop agreements allowing use by other federal agencies and industry on a user fee basis. The DOE selected the NNSS after a survey of potential sites. The Liquefied Gaseous Fuels Spill Test Facility was built for DOE and certified operational in 1986. It was later renamed the Hazardous Material Spill Center (HMSC) and since then has been renamed the Nonproliferation Test and Evaluation Complex (NPTEC). This unique facility provides a center where tests can be performed with hazardous chemicals and liquefied gaseous fuels.

NPTEC is located along the eastern edge of the NNSS within the general western side of Frenchman Lake, which is dry during most of the testing season. The area is extremely flat for several miles both upwind and downwind of the release points. NPTEC is used as a basic research tool for studying the dynamics of releases of various hazardous materials. Tests can focus on determining the physics of atmospheric dispersion of chemical releases, validation of equipment and techniques for chemical release detection, advanced hazardous material (HAZMAT) training, and effectiveness of mitigation technologies.

NPTEC consists of four test areas (see Figure 1-1 below), including the tank farm (Test Area 1, currently in mothball status), the wind tunnel, the spill pads, and the elevated stacks area. Located approximately one mile from the test beds is the control center. Also included within NPTEC are electronic shops, maintenance shops, a conference facility, storage buildings, and the East and West Motels. These Motels, approximately 186′ long by 14′ wide by 8′ high, are open-sided concrete structures created for above-ground testing and are currently used by NPTEC for storage.

Test Area 2 has a wind tunnel measuring approximately 8′ × 16′ × 96′ that is used to provide controlled environmental conditions for mixing and mitigation technology research. The wind tunnel design has also been used for controlled plume releases.

Two spill pads located in Test Area 3 are available for contained open-air releases of volumes of 50 to 1,000 gallons. This area has been mainly used by test sponsors for determining mitigation strategies for episodic releases of dense gaseous fluids and to provide HAZMAT training.

Test Area 4 also contains two elevated release stacks (approximately 50′ and 70′ in height), which can be used to simulate emissions from industrial facilities. Both release stacks and the wind tunnel have multiple, independently variable release source capabilities.

The facility is equipped with television cameras, a public address system, evacuation alarm, and radio networks. Closed circuit television is used to maintain visual contact between the release site and the Command, Control, and Data Acquisition Building to monitor activities. During a typical customer experiment, there are approximately 6 to 15 personnel (NSTec and subcontractors) providing support. During other periods, there are approximately 3 to 5 NSTec personnel working at NPTEC.

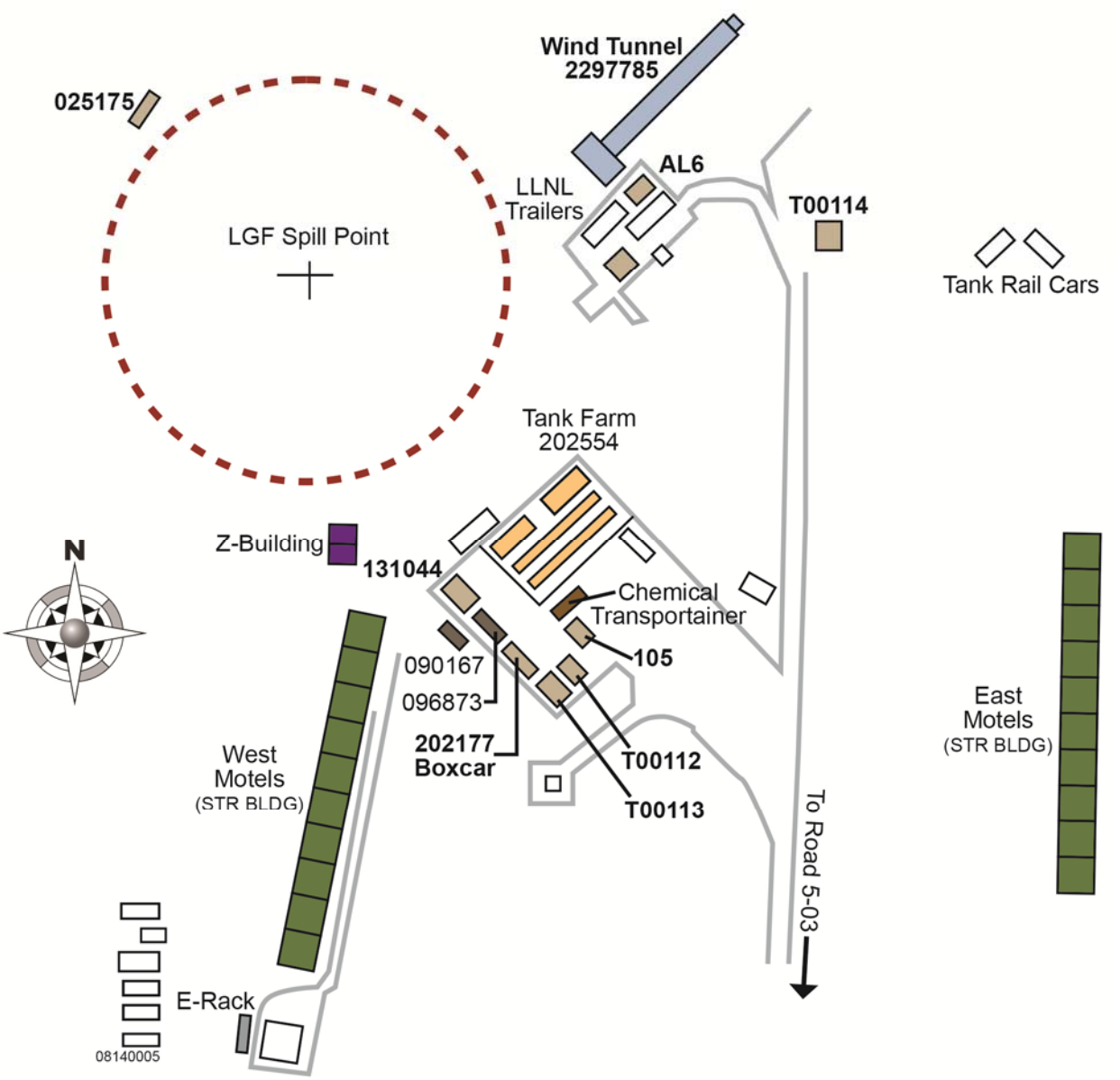


Figure 1-1. NPTEC Area Diagram

1.5.1 NPTEC Facility Management

Since inception of the NSTec Contract, NPTEC has realized a series of organizational changes. As illustrated in Figure 1-2 below, NPTEC has transitioned from being under to the Homeland Security and Defense Application (HS&DA) Directorate from 2006 to 2012 to now being "managed" by two directorates: Global Security (GS) and the Nuclear Operations Directorate (NOD). The purpose of this latest organizational re-alignment was to implement the Conduct of Operations (CONOPS) philosophy institutionalized within NOD.

Based on a series of interviews and document reviews, NOD is responsible for facility operations (e.g., routine maintenance, housekeeping, facility inspections), and GS is responsible for programs (e.g., customers). NPTEC has a Facility Manager (FM) and Alternate Facility Manager (AFM) who are responsible for authorizing performance of work and deconfliction, but these individuals are also responsible for other facilities at the NNSS. In a similar manner, the NSTec Safety Professional assigned to NPTEC is also responsible for eight other facilities at NNSS, including those located approximately 60 miles from NPTEC. During interviews and discussions, an additional individual identified himself as an Authorized Facility Manager. However, the FM confirmed that this is not an official title and that individual is not authorized to serve in a facility manager capacity. Refer to Section 10.0 for additional discussion on this topic.

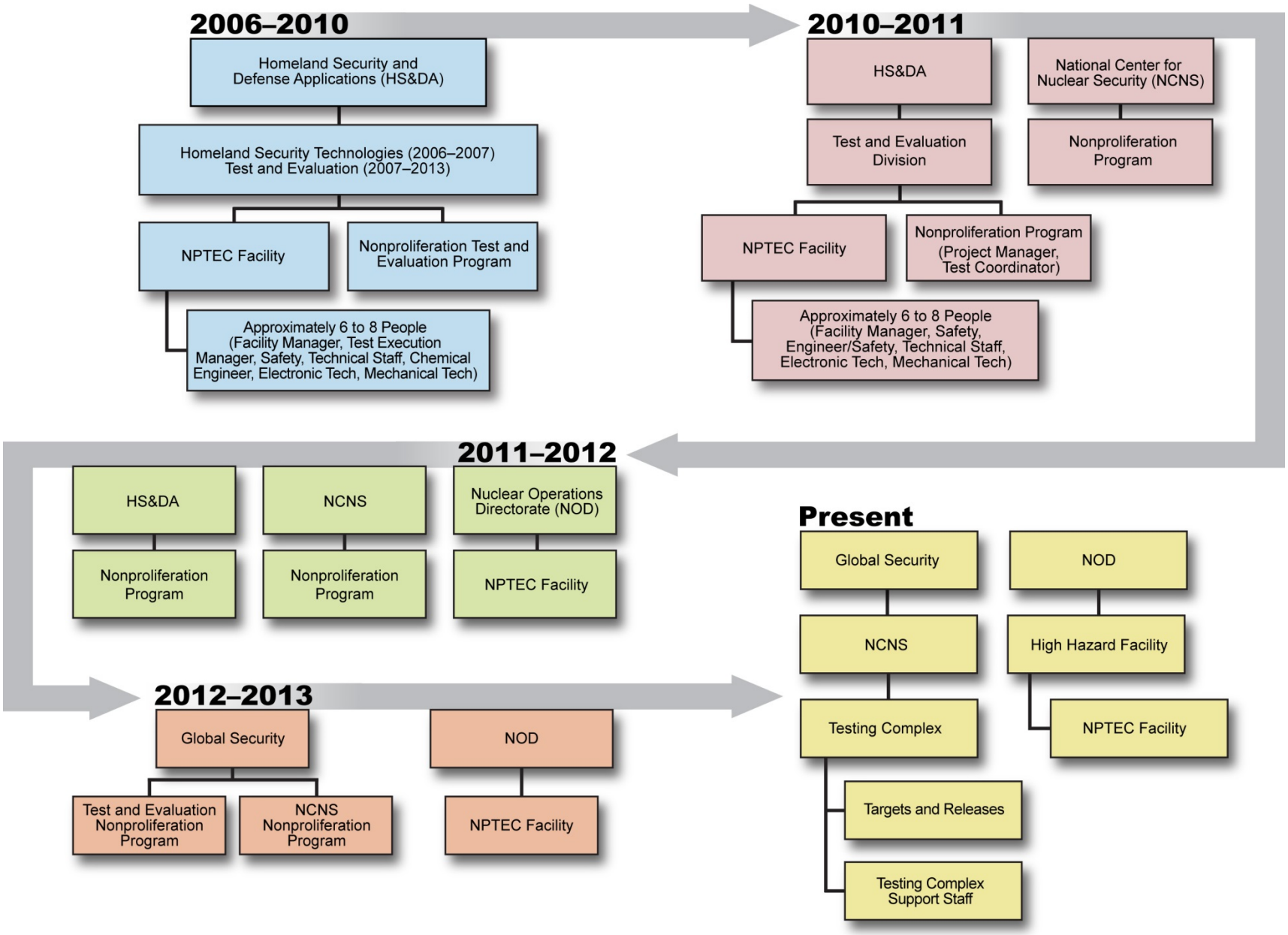


Figure 1-2. NPTEC Organizational Realignments

1.6 Scope, Purpose, and Methodology

The Board held an initial briefing on the afternoon of June 17, 2014; began its activities on June 18, 2014; and completed the investigation on July 23, 2014. Board activities were suspended on June 23, 2014, due to an Operational Pause declared by the NSTec President. The purpose of the Operational Pause was to meet with all NSTec personnel to discuss a series of recent incidents, including the chemical drum explosion/personnel injury that are the subject of this investigation.

The scope of the Board's investigation was to identify relevant facts; analyze the facts to determine the direct, contributing, and root causes of the event; develop conclusions; and determine Judgments of Need for actions that, when implemented, should prevent recurrence of the accident. The investigation was performed following the guidance provided in DOE-HDBK-1208-2012, using the following methodology:

- Facts relevant to the event were gathered through interviews and reviews of documents and other evidence, including photographs.
- Facts were analyzed to identify the causal factors using event and causal factors analysis, barrier analysis, change analysis, root cause analysis, and Integrated Safety Management (ISM) analysis.
- Judgments of Need for corrective actions to prevent recurrence were developed to address the causal factors of the event.

Accident Investigation Terminology

Causal factors are events or conditions in the accident sequence that contribute to the unwanted result. There are three types of causal factors: direct cause, root cause, and contributing cause.

The **direct cause** of an accident is the immediate event(s) or condition(s) that caused the accident.

Root causes are the causal factors that, if corrected, would prevent recurrence of the same or similar accidents. Root causes may be derived from or encompass several contributing causes. They are higher-order, fundamental causal factors that address classes of deficiencies, rather than single problems or faults.

Contributing causes are events or conditions that collectively with other causes increased the likelihood of an accident but that individually did not cause the accident. Contributing causes may be long-standing conditions or a series of prior events that, alone, were not sufficient to cause the accident, but were necessary for it to occur. Contributing causes are the events and conditions that "set the stage" for the event and, if allowed to persist or recur, increase the probability of future events or accidents.

Event and causal factors analysis includes charting, which depicts the logical sequence of events and conditions (causal factors that allowed the accident to occur), and the use of deductive reasoning to determine the events or conditions that contributed to the accident.

Barrier analysis reviews the hazards, the targets (people or objects) of the hazards, and the controls or barriers that management systems put in place to separate the hazards from the targets. Barriers may be physical or administrative.

Change analysis is a systematic approach that examines planned or unplanned changes in a system that caused the undesirable results related to the accident.

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2.0 THE ACCIDENT

2.1 Description of Work Activity

The NPTEC facility is designed for the release of chemicals into the atmosphere to support sensor development and calibration activities at two locations at the NNSS. Releases were planned at the NPTEC lake bed and solid targets at both NPTEC and Port Gaston facilities. The releases at the lake bed included but were not limited to static chemical target equipment construction and maintenance, and staging of chemicals and equipment. Work for this experiment was scheduled to start on May 19, 2014, and end on July 25, 2014.

Just prior to the time of the accident, the work activity included retrieving isopropyl alcohol (IPA) from a 55-gallon container from Bay 30 at the NPTEC West Motel storage location for the purpose of transferring to a smaller container for subsequent transport to target release area.

The three employees conducting the activity had been briefed on the Pre-Task Hazard Review (PTHR) at the Plan of the Day (POD) meeting. The PTHR included chemical hazards associated with handling chemicals and the proper personal protective equipment (PPE) to be worn: safety glasses, safety shoes, and protective gloves to prevent skin contact. Of the three employees, two were physically at the West Motel and one was located approximately 400 meters away at the display target area.

2.2 Accident Description

On Friday, June 13, at approximately 0830, an NPTEC project representative and an NPTEC subcontractor (who was wearing tennis shoes instead of safety shoes) entered Bay 30 of NPTEC's West Motel to transfer IPA from a 55-gallon drum into a project container. In support of this chemical transfer, the two personnel decided that a 55-gallon drum located at the front of Bay 30 needed to be moved to access other chemical drums inside the bay. The drum to be moved had previously been used to store IPA, which had been pumped from the drum on Wednesday, June 11. At the end of this pumping operation on June 11, the drum appeared to be empty and the lid was not placed back on the drum.

While the NPTEC subcontractor (Worker A) was lifting the open and apparently empty drum by hand on Friday, June 13, it unexpectedly exploded, resulting in the individual being projected out of Bay 30 approximately 8 feet due to the concussive effect of the explosion. The individual received non-life-threating injuries, due to being struck by drum shrapnel, as well as contusions.

The injured individual was transported by ambulance to University Medical Center (UMC) in Las Vegas, Nevada. The patient received stitches in the right calf and big toe of the right foot, and was released later that afternoon.

The balance of NPTEC personnel were immediately evacuated from the West Motel. WSI-Nevada personnel established road blocks in the immediate area to prevent unauthorized access. Later that morning, the NPTEC project representative who was in Bay 30 at the time of the explosion (Worker B) complained of ringing in the ears; he was examined by paramedics at the scene and released.

Figure 2-1. Post-Accident View of Event Drum and Spilled Liquid in Bay 30

2.3 Accident Response

At approximately 0852 on June 13, 2014, the NNSS Operations Command Center (OCC) Fire Dispatcher received a telephone call from a Nye County Sheriff 9-1-1 Dispatcher located in Pahrump, Nevada. The Nye County Sheriff Dispatcher reported that their center received a 9-1-1 call from NPTEC reporting a drum explosion with one person injured. They lost contact with the caller, but provided a call-back phone number (cell) to the OCC Fire Dispatcher. After terminating the call with the Nye County Sheriff Dispatcher, the OCC Fire Dispatcher attempted to contact the caller at NPTEC (number provided by Nye County Sheriff Dispatcher), but the call failed to connect.

The OCC Fire Dispatcher then activated the emergency tones at 08:53:34 in both Fire Station 1 (Mercury) and Fire Station 2 (Area 6) and provided the Public Address and radio channel dispatch message for a drum explosion with one injury at NPTEC. At approximately the same time, the OCC Duty Manager activated the 5001 ring-down line, delivering an emergency message that activates response by WSI-Nevada Security Police Officers, who in turn notify Nye County Sheriff's Deputies. Both fire stations began responding at 08:54:13 (8 vehicles, 17 personnel) code 3 (lights and siren).

At approximately 08:56:17, the responding Assistant Fire Chief (C-4) requested current weather data from OCC Fire Dispatch, which was provided at 08:56:46.

At approximately 08:58:50, the Local Emergency Director (LED) at NPTEC (also referred to in this report as Worker C) began communicating with C-4 over radio channel ERO-14 while emergency crews were en route to the scene. During this discussion, the LED changed the initial reported information from explosion to overpressure and a single patient with a laceration to his leg. The LED also stated that the scene was safe, with no chemical exposure risk, no fire present, and that he would meet them and lead them in to the scene.

Based on a single patient being injured, C-4 released Medic-2 for return to Station 2 and staged both fire engines and rescue vehicles out of the hazard area. C-4, along with the Emergency Medical Services Battalion Chief (C-6) and Medic-1, was escorted into the West Motel area by the NPTEC LED. They arrived at the incident scene at 09:04:39 and C-4 reported initial size-up information.

At 09:07:05, C-4 established Incident Command (IC) and named it NPTEC Command, with the initial command post being located near the incident scene. C-4 initially reported the chemical involved to be isopropylamine, but quickly corrected the name to isopropyl alcohol.

C-4 began taking digital photos of the incident scene, documenting the conditions and position of additional drums and a disabled vehicle used by the two workers present during the accident. While responders were treating the patient, the NPTEC LED contacted the OCC Duty Manager via telephone to provide an update on the incident. The OCC Duty Manager also placed a telephone call to the DOE HQ Watch Office advising the incident was not declared an operational emergency and provided basic incident information to the Watch Officer.

At 09:11:40, C-4 determined additional potential hazards were present (smell of chemicals, liquid present, remains of exploded IPA drum) and decided to evacuate all personnel from the West Motel area. The patient was treated, loaded in the ambulance, and all units pulled out of the hazard area and regrouped personnel and the command post to the 5-08 NPTEC building.

C-4 formed a Unified Incident Command (UIC) with a WSI-Nevada Lieutenant and Nye County Sheriff's Deputy, with C-4 being designated the Lead IC. He directed WSI-Nevada to establish roadblocks to isolate access into the NPTEC operational area. This was accomplished by 09:20:25.

A second worker positioned near the drum rupture began complaining of ringing in the ears. The Lead IC requested a second medic unit to evaluate the patient for possible transport at 09:28:19. The patient was evaluated by the paramedics, the on-call NSTec Physician was consulted, and the patient was released to full duty.

With the patients treated and the area isolated, the UIC began piecing together incident information, such as chemical inventories for the West Motel area, and potential causes of the drum over-pressure or explosion. The NPTEC LED became one of the subject matter experts (SMEs) utilized by the UIC to plan incident actions.

At 10:00:00, a decision was made to activate the Emergency Operations Center (EOC) Monitoring Team to support the incident management activities. The OCC Duty Manager activated the communicator system for the EOC Monitoring Team to report to the EOC as soon as possible. The Lead IC requested that the OCC Fire Dispatcher provide weather updates to the UIC every 15 minutes until further notice.

At 10:14:44, a combined team of NNSS F&R and NPTEC personnel, with approval of the UIC, entered the operational area outside the isolation zone to shut down several generators. The UIC recognized

further entry for mitigation would not be possible until additional specialized resources were deployed to assist.

At 11:38:34, NNSS F&R resources held in the staging area were released for return to their respective fire station in a standby mode.

The UIC requested mutual-aid activation of the Las Vegas Metropolitan Police Department (LVMPD) ARMOR Team to assist with robotic entry into the incident to eliminate risk to responders. Several phone calls were made with ARMOR Command Staff briefing them on conditions, and they deployed from Las Vegas at 12:42:58. The EOC Monitoring Team conducted conference calls with the UIC to review operational objectives and resource needs, and assisted with ARMOR access to the NNSS. The ARMOR Lieutenant contacted the UIC and advised that elements of the Nevada Army National Guard, 92nd Civil Support Team (CST), would be joining them in the deployment to the NNSS.

With inbound resources en route to the NNSS, the UIC requested that NNSS F&R's mobile incident command post vehicle be deployed to NPTEC. The UIC was relocated to this vehicle and staged on the 5-03 road adjacent to the dry lake bed outside the hazard area to provide a better location for coordinating entry operations.

The NNSS F&R resources staged at the fire stations were again deployed to NPTEC to support the mutual-aid resources. The ARMOR and CST resources arrived at 14:48:57. The UIC planned robot entry activity objectives for visual recon of the remaining drums of IPA. The EOC Monitoring Team was apprised of the entry operations and concurred with the action plan.

The robot made entry and moved a few drums in an attempt to determine which drums were empty and full. During this activity, the robot did not respond to commands and a second robot was used for recovery. Once this was accomplished, the robots exited the area and a plan was developed to keep the area isolated and secure until recovery operations were planned. The NNSS F&R, ARMOR, and CST resources demobilized and departed the NNSS at 18:56:00.

2.4 Event Chronology

Table 2-1. Event Chronology

Date/Time	Activity
1986	Facility certified operational
2002	First identification of IPA at the facility. IPA is not located in the West Motel
7/28/2003	110-gallon cylinder containing 55 gallons of hydrochloric acid (HCl) found ruptured. Corrective actions included: • Chemical Handling Work Package revised to address material compatibility issues • Hazardous Operations work instruction revised to address issue of equipment environment not being considered • Dedicated full-time equivalent (FTE) employee hired to fill Engineering role previously performed by Chemical and Systems Engineer
2006	Hazardous Substance Inventory indicates that IPA has been moved into the West Motel
7/1/2006 to 2010	NSTec assumes M&O role: • HMSC Facility/Program under HS&DA for Work For Others (WFO) program • HMSC Facility ~6–8 FTEs • HMSC Facility develops work packages, checklists, procedures • HMSC redesignated as NPTEC • Issues identified regarding staffing levels and chemical segregation
2010	Mandatory Fire Safety Assessment placed on hold due to lack of funding
2011	Hazardous Substance Inventory identifies IPA in West Motel, Bay 30 (Accident Location), for the first time and shows that it is collocated with HCl
9/30/2011	NSTec designates NPTEC as a High Hazard Facility under Conduct of Operations (CONOPS)
10–12/2011	CONOPS Management Assessment performed by NPTEC Management. This assessment identifies 15 findings. Training and labeling deficiencies not corrected due to lack of funding
4/2012	NPTEC Work Control Management Assessment identifies seven findings. Five of these are closed without effective corrective action
4/3/2012	NNSA/NFO approves the NPTEC CONOPS Matrix
7/2012	Fire Hazards Analysis (FHA) developed, but it does not identify the presence of flammable chemicals in the West Motel
≈7/2012	NPTEC facility and operations inconsistent with management expectations: • NPTEC CONOPS concerns raised to Senior Management Team • Decision made to bring operational rigor to NPTEC facility and operations • Staffing 6–8 FTEs
8/8/2012	NPTEC facility management transferred to NOD with the intent of improving the rigor of facility operations. The GS NPTEC Facility Manager is reassigned as the NPTEC GS Project Manager and a NOD Facility Manager is assigned. The NOD Facility Manager, however, manages multiple facilities and does not dedicate a significant portion of attention to NPTEC

Table 2-1. Event Chronology (continued)

Date/Time	Activity
8/2012	NOD management recognizes issues with chemical management and requests a site assistance assessment from NSTec Facility Oversight Department. However, NOD Management also directs that the assessment not be included in the established assessment and issues tracking systems. The assessment results in 15 findings indicating significant programmatic weaknesses, of which only 10 are entered into the issues management system, and these are given the lowest possible priority
2012	Industrial Hygiene (IH) identifies a programmatic problems with chemical control; however, the findings are ultimately placed on hold in the issues management system due to lack of funding (approx. $12,000)
2012–2013	NPTEC reduces its dedicated staffing from 6 to 3
2013	NOD requests funding to disposition legacy chemicals at NPTEC; however, the requested funds are removed from the final budget
1/1/2014	NSTec designates NPTEC as a Moderate Hazard Facility under CONOPS. Apart from implementation of CONOPS, there is no additional rigor applied to analysis of hazards associated with Moderate Hazard Facilities than what is applied at Low Hazard Facilities
2/2014	Barolo II work planning started. The use of IPA is identified in the scope of work; however, there is no field walk-down or tabletop review. Nor does the scope of the work package encompass the transfer of IPA at the West Motel
5/2014	The Barolo II work package is revised to add hot work. The use of IPA is still identified in the scope of work; however, again there is no field walk-down or tabletop review. Nor does the scope of the work package encompass the transfer of IPA at the West Motel
6/2/2014	IH performs a Health Hazard Evaluation (HHE) of the West Motel, which does not identify hazards or issues identified with storage of chemicals
6/11/2014	Workers remove the lid from the event drum and transfer IPA to a transfer container in support of Barolo II test, although the transfer is not included in the work package scope of work. As part of this evolution, the workers tilt the event drum to remove as much IPA as possible with available equipment. During the transfer, the workers identify “sloughing” of the drum liner and report the unexpected condition to supervision and the customer. Due to poor communications, supervision believes that a different drum is involved and the customer only looks at the condition as it might impact the test criteria. When finished with the transfer, the workers leave the lid off the drum to aid in evaporation of the small amount of IPA remaining in the drum and exit the area without incident
6/12/2014	Barolo II testing is performed with IPA drawn the previous day, and the West Motel is not entered
6/11–13/2014	IPA evaporation in open event drum allows for concentration of peroxides
6/13/2014 ≈0730	A POD is conducted. General chemical hazards are discussed and the PTHR and Hazard Communication document reviewed. The peroxide formation hazard is not discussed because its potential had never been identified
6/13/2014 0730–0845	Field activities commence and Workers A, B, and C go to test area to set up test conditions
6/13/14 ≈0745	Workers A and B go to West Motel, Bay 30, when it is determined that they need additional IPA to set up the test conditions

Table 2-1. Event Chronology (continued)

Date/Time	Activity
6/13/2014 ≈0750	Workers A and B look in the event drum and identify that the liner sloughing is worse, but they do not notify supervision due to the response that they had received on 6/11/2014
6/13/2014 ≈0750	The empty event drum is impeding their access to a drum containing IPA, so they decide to move it. As Worker A prepares to move the drum, Worker B moves towards the interior of the Bay
6/13/2014 ≈0850	**Open-top drum explodes when Worker A lifts it by hand**
6/13/2014 0851	Worker B attempts to use radio to make notification but is unable to make contact. He then uses his cell phone to dial 9-1-1 and contacts the Nye County Sheriff Dispatcher
6/13/2014 08:52:00	Nye County Sheriff Dispatcher notifies NNSS Fire Dispatch that they have received a 9-1-1 call reporting an explosion with injuries at NPTEC. NNSS Fire Dispatch immediately dispatches Station 1 and 2
6/13/2014 08:53:00	WSI-Nevada is notified of the incident via 5001 ring-down
6/13/2014 08:58:19	The NPTEC LED contacts the OCC and provides notification that an empty drum had ruptured, resulting in lacerations to a worker, and that there was no release of chemicals and the area was safe
6/13/2014 09:04:58	F&R arrive at West Motel and identify IPA on the ground
6/13/2014 09:08:00	NPTEC LED contacts the OCC and notifies them that there was no explosion. He states that a 55-gallon container with isopropyl alcohol residue breached due to over-pressurization, an individual received a leg laceration, and that the event was an occupational injury and not an operational emergency. Based on this information, F&R responders remove their self-contained breathing apparatus (SCBA)
6/13/2014 09:10:00	The OCC Duty Manager notifies DOE HQ
6/13/2014 09:11:44	F&R units determine that nature of the rupture and presence of additional 55-gallons drums of IPA impose unexpected hazards and that all personnel will have to be evacuated from the area
6/13/2014 09:17:00	NNSA/NFO Facility Representative notified
6/13/2014 09:23:33	Unified Command established with WSI-Nevada. Nye County en route
6/13/2014 09:28:00	Worker B reports ringing in the ears, and a second F&R unit is dispatched to the NPTEC compound from Station 2
6/13/2014 09:29:00	NSTec Emergency Manager notified
6/13/2014 10:00:00	The EOC Monitoring Team members notified via Communicator to activate the Monitoring Team at 11:30 at the North Las Vegas Facility
6/13/2014 10:10:37	Stop Work established
6/13/2014 10:24:47	Medic 1 arrives at UMC – Trauma ER with Worker A
6/13/2014 10:40:54	NNSA/NFO Manager briefed
6/13/2014 11:31:02	Worker B treated and released at the location
6/13/2014 11:34:35	EOC Monitoring Team formally activated
6/13/2014 19:06:31	F&R units return to stations
6/16/2014 08:41:32	EOC Monitoring Team declared operational
6/16/2014 08:55:19	NSTec employee who received ringing in the ears verified to be evaluated by NNSS Occupational Medicine and is listed as full duty status
6/16/2014 17:08:15	EOC Monitoring Team secured until 1200 on 6/17/2014
6/16/2014 1722	Occurrence Reporting and Processing System (ORPS) Notification Report submitted

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3.0 AUTHORIZATION BASIS

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A facility's Authorization Basis (AB) is the collection of documentation that supports the decision to allow a facility to operate or an activity to be performed. It is the basis by which NNSA/NFO accepts the risk associated with permitting the facility to operate or conduct activities. This includes regulatory requirements, permits (e.g., air, water), Safety Basis (SB) (e.g., Documented Safety Analysis hazards assessment), and corporate operational requirements (e.g., policies, procedures).

In broader terms, AB refers to the combination of information relating to the control of hazards at a facility through design, engineering analyses, and administrative controls upon which NNSA/NFO depends for its conclusion that activities at the facility can be conducted safely. A proper AB for a facility is one that allows NNSA/NFO to be knowledgeable of the work being authorized and the risks associated with performance of the work. The requirements and controls used to establish an AB are flowed into a facility's performance documents via procedures and/or the work control process.

Although AB and SB are terms well defined in association with nuclear facilities, the AB for non-nuclear facilities at the NNSS refers to the operational envelope established by the NNSA/NFO-approved Real Estate Operations Permit (REOP). An inherent part of the REOP is the data or information contained in the REOP, attached to the REOP, or identified as web link references to include associated environmental permits and emergency management documents required for operation.

This section will focus on overall authorization. Hazard identification, environmental permitting, and emergency management will be addressed in other sections of this report.

For its NNSS operations, NNSA/NFO utilizes REOPs developed according to NNSA/NFO Order NSO O 412.X1F, "Real Estate Operations Permit," as implemented through NSTec Company Directive CD-G610.017, "Work Authorization (Real Estate Operations Permit, Facility Execution Plan, and Support Execution Plan)," to ensure that work performed under its purview is clearly defined, properly authorized, and has distinct geographical boundaries. An approved primary REOP, or a combination of a primary REOP and one or more secondary REOPs, constitutes authorization to conduct work within the defined boundaries of real estate and safety envelope described. REOPs form the basis for the Nevada Facility User Model, which defines the NNSA/NFO "user facility" concept. Under the user facility concept, secondary REOP holders are authorized to perform hands-on programmatic work in facilities managed by the primary REOP holder.

In the Nevada Facility User Model, a primary REOP holder designated by NNSA/NFO is responsible to review and ensure activities and operations conform to the AB for the permitted facility/activity and to revise the AB to include the scope of work identified in a secondary REOP. Standardized, site-wide safety management programs are preferred, but primary REOP holders should accept secondary REOP holders' processes and procedures developed under an NNSA/NFO-approved Integrated Safety Management System or equivalent.

Secondary REOPs authorize programmatic work, assign safety responsibility at the activity level, and, together with the primary REOP, document the roles, responsibilities, and relationships between the primary and secondary REOP holders. In this model, contractor/user organizations may assign their staffs to jointly complete work using shared plans and procedures, subject to the requirements identified in the Contractor Requirements Document of NSO O 412.X1F. Ideally, the integrated set of primary and secondary REOPs, Facility Execution Plans (FEPs), and Support Execution Plans (SEPs) define the specific work, functions, and the associated hazards for a given location.

As Found Conditions

Based upon document reviews and multiple interviews, the Board determined that the AB established by NSTec for the NPTEC facility is the Primary REOP NSTEC-0033, "NOD HiMed Fac," including its attached "Facility Execution Plan (FEP) for NSTEC-0033," and SEP-B725-00, "NSTec Support Execution Plan (SEP) for Nonpro Test and Eval Comp." Secondary REOPs include those for NNSS infrastructure and project-specific activities. The secondary REOPs associated with NSTEC-0033 are as follows:

- AC-0001 – Aerospace Corporation
- ARL/SORD-0001, Weather Support for the NNSS
- DOD-0021, Turing Aviation
- DRI-0004, Nevada Desert Research Center
- DUPONT-0001 – DuPont Mitigation Workshop
- NGC-0001 – Highland
- OGA-0004 – OGA Tarantula Test Activities
- OGA-0010, Breakout
- PNNL-0003 – T-Genie
- RITI-0001, RITI Air Operations
- SNL-0004, Sandia Seismic Network
- UAS-0001, Unmanned Aerial System
- USGS-0003, USGS Vegetation, Small Mammal, and Reptile Studies
- USGSES-0002 – Leo Test Series

The primary hazard identification document for NPTEC associated with AB approval is SEP-B725-00. This document describes the facility assets and reviews the hazards associated with facility operations pertinent to this investigation.

The NPTEC REOP captures the FEP and SEP hazards associated with the facility and details the physical location where those hazards exist. Both the FEP and SEP contain a series of questions to assist with identification of potential hazards, including those associated with purchasing of chemicals and their subsequent use, handling, and storage. The answer to each question defines the hazard and incorporates the physical location where the hazard is allowed to be present.

The questions specific to chemical handling and storage typically conclude with statements such as "The assigned facilities serve as control center, offices, chemical storage and warehouse supplies during the events" or "Facilities listed are associated with chemical storage." This is the mechanism that serves as the authority to undertake activities at a specific location.

Although the REOP's Scope of Work/Safety Envelope section specifically states that the Motels are used for chemical storage, the Board noted that the assigned facility lists for chemical storage did not include the West Motel, and not all SEP-identified hazards associated with chemicals have been incorporated into the REOP. Only a single question concerning the presence of hazardous materials in West Motel was captured, and a hazard analysis was not performed addressing storage of chemicals. This oversight takes on more importance due to the broad spectrum of hazards to be evaluated through this process, including those that could result in a Site Emergency if not properly managed, and, from a programmatic perspective, the condition equates to a Potential Inadequacy of the Safety Analysis (PISA) had it occurred in a nuclear facility.

The Board provides an in-depth evaluation of Conduct of Operations in Section 5.0. However, an element of that program's implementation is pertinent to the establishment of the SBs and ABs for

NPTEC and NSTec's other Moderate Hazard Facilities as defined in CD-NOPS.005, "Implementation of Formality in the Workplace for NSTec Facilities," and requires further discussion.

CD-NOPS.005 clearly identifies NPTEC as a facility designated by the NNSA/NFO Manager as requiring a Conduct of Operations Program. CD-NOPS.005 further describes NPTEC as a Moderate Hazard Facility. Absent NPTEC's NNSA/NFO-directed inclusion in the Conduct of Operations Program, the Board concurs that the hazards present in NPTEC would still meet the threshold levels for a Moderate Hazard Facility according to CD-NOPS.005, Appendix A, "NSTec Graded Approach to Implementing Formality in the Workplace Decision Flowchart."

The Board's interest, however, is not in the level of the facility classification, but rather in the classification's impact. As currently implemented, the only process-based difference between Low and Moderate Hazard Facilities is the existence of a Conduct of Operations Matrix (i.e., NSTec Form FRM-2542, "Formality in the Workplace Outline") and the graded implementation of Conduct of Operations principles. More rigorous hazard identification, analysis, and control processes are not implemented nor documented in the REOP, FEP, or SEP.

Although NSTec Management has made it clear to the Board that the Moderate Hazard Facilities are being held to a higher standard across all areas, there are no mechanisms other than Conduct of Operations to drive the expected increased level of rigor. While Conduct of Operations would be critical to safe and effective mission operations, its application comes into play only after the hazards are identified and analyzed, and controls established in support of the AB. Ideally, risks are understood and the implementation of Conduct of Operations can be graded appropriately. However, NOD has not established minimum AB criteria for operation and maintenance of NOD Moderate Hazard Facilities.

CON 1 **The West Motel was not appropriately analyzed or approved for chemical storage in the NPTEC REOP.**

CON 2 **The periodic review, update, and approval of NPTEC facility documentation did not identify hazards associated with storage of chemicals at the West Motel.**

CON 3 **NSTec has not required establishment of comprehensive "authorization basis" documentation, or equivalent, to ensure Moderate Hazard Facilities are operated in a safe and compliant manner.**

JON 1 **NSTec needs to ensure that the NPTEC REOP addresses all potential hazards and their locations, including storage of chemicals.**

JON 2 **NSTec needs to perform an Extent of Condition review of REOPs for other Moderate Hazard facilities to ensure that all potential hazards are identified and appropriately mitigated.**

JON 3 **NSTec needs to develop comprehensive "authorization basis" documentation, or equivalent, for Moderate Hazard Facilities.**

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4.0 CHEMICAL SAFETY

Ideal State

An effective chemical management program consists of a “cradle to grave” methodology whereby the overall process is a cycle of interrelated elements, addressed in terms of the hazards posed by chemical usage. The process begins during the planning of work prior to acquisition and continues through the final disposal of the chemical. The hybrid term Chemical Safety and Lifecycle Management (CSLM) is meant to convey the concept of safely managing the lifecycle of chemicals in the context of ISM to ensure that all aspects of chemical safety and management are coordinated and adequately addressed.

Effective acquisition management facilitates the procurement of needed chemicals based on work planning, an approved hazard analysis, and lifecycle analysis. A structured process ensures consideration is given to a number of important factors, including the hazards involved, justifiable quantities, use of available excess chemicals in lieu of new purchases, stability/shelf life, suitability of storage facilities, and appropriate means for final disposition.

Upon chemical receipt, each container is entered into a site-wide chemical management tracking system. This electronic database allows assignment of a unique identification number, as well Chemical Abstract Index identification, manufacturer, quantity, expiration date, etc. Hazards and controls are evaluated and entered into the system based on the relevant safety documentation (e.g., material safety data sheet [MSDS]). The identification number is included on the container label for real-time tracking in the field. Owners are assigned to each container and made accountable for accurate tracking and proper storage of the container, as well as appropriate disposal when the chemical is no longer required. The system is capable of notifying owners when chemical testing is due and when expiration dates are approaching. The inventory record is updated each time the chemical is used, permanently moved, or tested. All chemical containers are routinely inspected for condition and proper labeling and physically inventoried at least annually.

Chemical storage includes all chemical phases and all types of containers including, but not limited to, tanks, piping, cylinders, and containers of solid, liquid, or gaseous chemicals. Storage includes all chemicals or chemical products, including used and unused chemicals, sealed, opened, or partially filled containers, working solutions, and day-use containers. Chemical quantities, incompatibilities, and shelf lives are important considerations in the management of storage locations.

Site operations and activities are managed to minimize the generation of hazardous waste while also continually striving to reduce the quantity of waste requiring treatment, storage, or disposal. An effective CSLM Program ensures that processes are designed to minimize the purchase and use of hazardous chemicals to prevent worker exposures or inadvertent environmental release.

Upon project termination, the associated chemical inventory must be appropriately managed. Chemical reuse at the facility or on site is the first choice in lieu of purchasing new chemicals. Otherwise, alternative potential disposition paths are considered, including external use by other DOE sites or use by other federal agencies; return of unused chemical to the vendor, if possible; and third party recycling of eligible chemicals. Disposal as waste is considered as the final option in the chemical disposition process.

As Found Conditions

In accordance with 29 CFR 1910.1200(e), "Written Hazard Communication Program," NSTec has a company directive (CD-P450.008, "Hazard Communication and Hazardous Substances Use and Storage") that describes the NSTec Hazard Communication (HAZCOM) Program. CD-P450.008 provides direction for hazardous substance review, hazard communication, and proper storage, use, and handling of hazardous substances. At the facility level, NSTec Organization Procedure OP-B725.001, "NPTEC Hazardous Materials Management," is implemented to supplement CD-P450.008 and assist NPTEC personnel when ordering, receiving, shipping, storing, or disposing of hazardous material.

Although some elements of a CSLM Program are in place, the associated requirements and guidance are fragmented and implemented by different organizations within the company. The NPTEC hazardous materials management procedure, dated September 30, 2010, was not updated by NOD to clearly define roles and responsibilities or incorporate the specificity and level of detail necessary to effectively manage the chemical inventory.

In most cases, an Authority Having Jurisdiction (AHJ) is responsible for overseeing chemical management at the corporate level, with an emphasis on enforcing chemical safety expectations at the facility level. Although the AHJ role is not well defined for chemical safety, dedicated oversight by an individual with the requisite subject matter expertise is critical. In the case of NPTEC, and other areas involving hazardous chemicals, the Board believes it is appropriate for an AHJ to oversee programmatic implementation of the Chemical Management Program and ensure that NSTec facility managers are actively engaged in implementing corporate-level direction associated with CSLM.

4.1 Hazard Identification and Analysis

NSTec Core Company Directive CCD-QA05.001-003, "Activity Level Hazard Analysis Process," describes the process used to identify potential hazards associated with activity-level work and assess the potential for worker injury. These efforts help identify the hazards associated with the process, activity, or substance and define the necessary controls to protect the worker, the public, and the environment. Section 14.0 includes additional discussion regarding how the process is implemented to support activity-level work at NNSS.

The manufacturer's MSDS is an important component of product stewardship and occupational safety and health. It is intended to provide workers and emergency personnel with procedures for handling or working with the hazardous substance in a safe manner, and includes information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. The MSDS must be readily available to employees where potentially harmful substances are handled in the workplace under the Hazard Communication regulation.

Reviews of MSDSs by the U.S. Chemical Safety and Hazard Investigation Board have detected dangerous deficiencies, reinforcing the need to periodically review existing documents and replace with updated versions. A current MSDS is essential to the hazards identification and analysis process.

The NSTec HAZCOM directive describes the process used to manage and maintain the MSDS list (index) in the front of each MSDS book or file of all hazardous substances listed within that particular book or file. Requirements exist to "Perform an annual review and update of the MSDS book/file to confirm the accuracy of its contents," and "Replace outdated MSDSs with current versions for substances in use." However, there were no provisions to confirm at any periodicity that the most

recent MSDS (incorporating new chemical hazard information) is available for use. There was no evidence that demonstrated the required annual reviews were being performed.

The NPTEC Test Chemicals MSDS Index was not developed and maintained in accordance with the NSTec HAZCOM directive requirements. The NPTEC Test Chemicals MSDS Index provided to the Board did not incorporate the details above and did not provide linkage to the individual MSDS documents. The hazards were not identified as required by the directive. The index is simply an alphabetized list of chemicals by product name. Handwritten notes reflect changes (chemicals added) to the initial list.

Review of the NSTec Hazardous Substance Inventory (HSI) database for multiple individual NPTEC assets contained on the Facility Data Warehouse (FDW) led to broken web links or links to MSDSs and in some cases Industrial Safety Cards that dated as far back as 1985. Further review established that this condition is common to all NNSS assets carried on the FDW. In addition, some existing MSDS formats are not consistent with the HAZCOM standard, making them extremely difficult to use. Furthermore, the age of many MSDSs raises the question of their usefulness to the worker and their current applicability for hazard identification and control.

By way of example, the NPTEC MSDS for IPA, dated April 2004, is not the manufacturer's MSDS. It was developed by ChemWatch, an independent organization specializing in comprehensive MSDS management, chemicals management, and first response software. Although the existing MSDS contains the minimum information required, it does not have the level of specificity available in a current MSDS for this chemical. For example, the existing MSDS does not address Hazards Not Otherwise Classified, including the formation of explosive peroxides. The existing MSDS states that the "product is considered stable," but does not address known stability concerns, including the formation of shock sensitive peroxides. The existing MSDS also notes the user should "Observe manufacturer's storing and handling recommendations."

4.2 Acquisition

Acquisition includes approval and procurement of chemicals and chemical products for individuals or organizations requiring chemicals to be brought onsite. CCD-QA07.001, "Procurement Process," establishes the mechanisms used to determine the need, acceptability, and appropriate procurement requisition processes, including requirements definition, requisition review and approval, methods of purchase, request for proposal and quotation, award of contract/subcontract, acceptance of items and services, monitoring and evaluation of supplier performance, material receiving and acceptance, and procurement of commercial grade items.

The facility-specific hazardous material selection and ordering process is described in OP-B725.001. The procedure defines high-level responsibilities assigned to the NPTEC Facility Owner, NSTec IH, and NPTEC Environment, Safety, and Health (ES&H) staff including review and approval of the manufacturer's MSDS prior to purchase. The Facility Owner verifies that capabilities exist to meet the minimum recommended material handling and storage requirements stipulated by the MSDS, including maximum duration of storage, prior to purchase. NPTEC ES&H ensures that all environmental, safety, health, signage, and storage issues have been addressed prior to ordering any hazardous material. The procedure does not address peroxide-forming chemicals and the need to purchase these substances in limited quantities.

The Board observed that a large quantity of legacy chemicals (i.e., in excess of 2,000 gallons) has accumulated in the NPTEC West Motel storage bays. Interviews indicated that chemicals in excess of defined project needs were typically ordered and subsequently left at the facility pending reuse or

disposal. As a result, excess hazardous material continued to accumulate over many years. There were no effective procurement controls in place, including provisions for reuse of existing chemical inventory and source reduction that ensures only the minimum amounts of chemicals needed to perform planned work are ordered.

4.3 Inventory Management and Tracking

OP-B725.001 includes high-level expectations for procurement, shipping, receiving, handling, storage, and disposal of hazardous materials at NPTEC. However, the procedure does not adequately address chemical inventory and tracking at the facility level to ensure current and reliable information is available throughout the entire chemical life cycle covering procurement, storage, use, transfer/movement, and final disposition.

CD-P410.012, "Hazardous Substance Inventory and Reporting," outlines requirements and responsibilities for collecting data and reporting information for the annual HSI at all NSTec facilities. The HSI is updated annually, and information collected is used primarily to determine whether federal or state hazardous chemical or hazardous substance thresholds have been exceeded for the previous calendar year.

The HSI is not an effective tool for chemical inventory management and tracking. NSTec does not have an automated corporate-wide chemical inventory and tracking system in place. Inventory lists for numerous chemicals present at the NPTEC site at the time of the accident were not accurate or complete and did not contain important information, including the name of the manufacturer, date of receipt, amount of chemical present, and the identity of the container material. There is no mechanism to identify chemicals with an expired shelf life so that they can be dispositioned appropriately. Based on the information available, NPTEC could not determine how long the IPA involved in the accident had been stored at this site.

Ownership of specific chemical containers has not been maintained over time. In many cases it is not clear who is accountable for these chemicals. Periodic reviews are not being conducted to identify and dispose of materials that are not assigned a specific future use. Some incompatible chemical storage (acids and alcohols) was identified. Unstable chemicals are not identified, tracked, or monitored. These deficiencies have resulted in the accumulation of a large volume of legacy chemicals, which represents a significant hazard to the facilities and personnel at NPTEC.

4.4 Chemical Storage

In accordance with company requirements, NPTEC hazardous material staging and storage areas are to be maintained in a clean, safe, and clutter-free condition at all times. The technical staff and/or assigned ES&H staff are required to check the hazardous material storage areas on a weekly basis and report any conditions that could indicate potential deterioration of chemical containers to ES&H. In accordance with OP-B725.001, the results of the checks, including any storage and labeling concerns, are recorded on the NPTEC Facilities ES&H Inspection Report, Appendix 1 (now Form FRM-2445, "NPTEC Facilities Area 5 ES&H Inspection Monthly Report"). However, no evidence exists to demonstrate that all the required periodic ES&H checks have been performed at NPTEC, as the reports could not be produced for the Board.

Electrical grounding and bonding is used in the storage areas to minimize fire and explosion hazards. All flammable hazardous material containers at the NPTEC West Motel are grounded while in storage to prevent static discharge. The containers are stored off the ground, on spill containment pallets. The passive grounding systems must be approved for their intended use and in good physical condition.

Visual observation indicated that the grounding systems are in place. However, in order for the grounding system to be an effective control, there needs to be direct metal-to-metal contact between the grounding system and the container. Visual inspections performed after the accident indicated that corrosion products and paint may be inhibiting the ability of the grounding system to adequately prevent static charge buildups (see Figure 4-1). Furthermore, interviews confirmed that no evidence exists in the form of tests or inspections to demonstrate that the minimum functional capabilities (e.g., resistivity) of the NPTEC grounding systems are met to ensure safe operations. This is of particular concern to this Board due to the safety function that would be provided by a viable grounding system.

Figure 4-1. Example Drum and Grounding System Conditions at West Motel

NSTec flammable/combustible storage requirements specify that no more than a one-day supply of flammable or combustible liquids shall be stored in a single fire area outside an approved flammable liquid storage cabinet or an approved flammable liquid storage room. The NPTEC West Motel is used to store quantities of flammable/combustible liquids far in excess of a one-day supply. However, the West Motel is not an “approved flammable liquid storage room,” as required by CD-P280.029, “Flammable/Combustible Liquids and Aerosol Products.”

Hazardous chemicals at NPTEC must be stored in approved, properly marked, or labeled containers. Labels on containers used for storing hazardous chemicals must include the chemical identification and appropriate hazard warnings. However, existing manufacturer’s labels on incoming containers of chemicals are not always maintained. Interviews with NPTEC staff confirmed that outdoor storage and continuous exposure to the elements causes labels to degrade over time (see Figure 4-2). These labels are not always replaced in a timely manner. Accordingly, many of the containers used for storing hazardous chemicals at NPTEC are not appropriately labeled (see Figures 4-3 and 4-4).

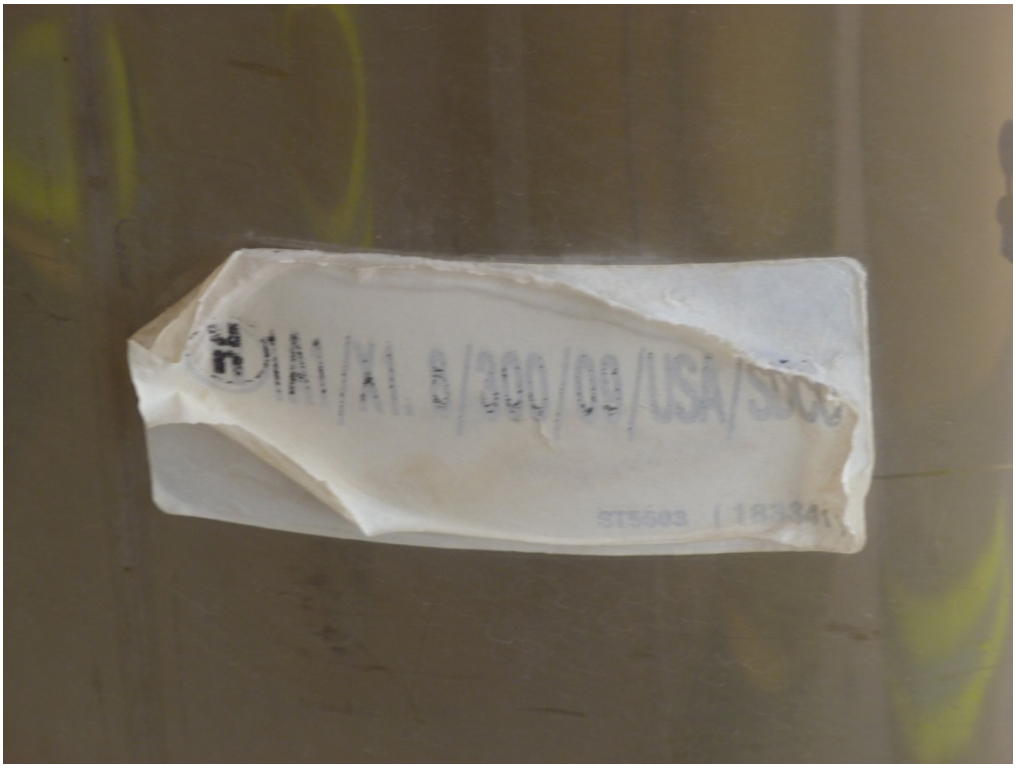

Figure 4-2. Example of Weathered Drum Label

Figure 4-3. Improvised Tape Label

MSDS and label information must be followed for storage requirements, including segregation according to hazard category and compatibility. Existing requirements prohibit storage of solvents, oils, and alcohols in the same location as strong acids and alkalis. When separate storage is required, the facility must provide for physical separation, such as a barrier to prevent mixing either from off-gassing or accidental spill or a separate storage area for incompatible substances. The NPTEC West Motel consists of multiple concrete barriers that physically separate individual storage bays. However, incompatible chemicals (e.g., isopropyl alcohol and hydrochloric acid) were collocated within the same storage area. Based on the HSI database, this condition has existed since calendar year 2011.

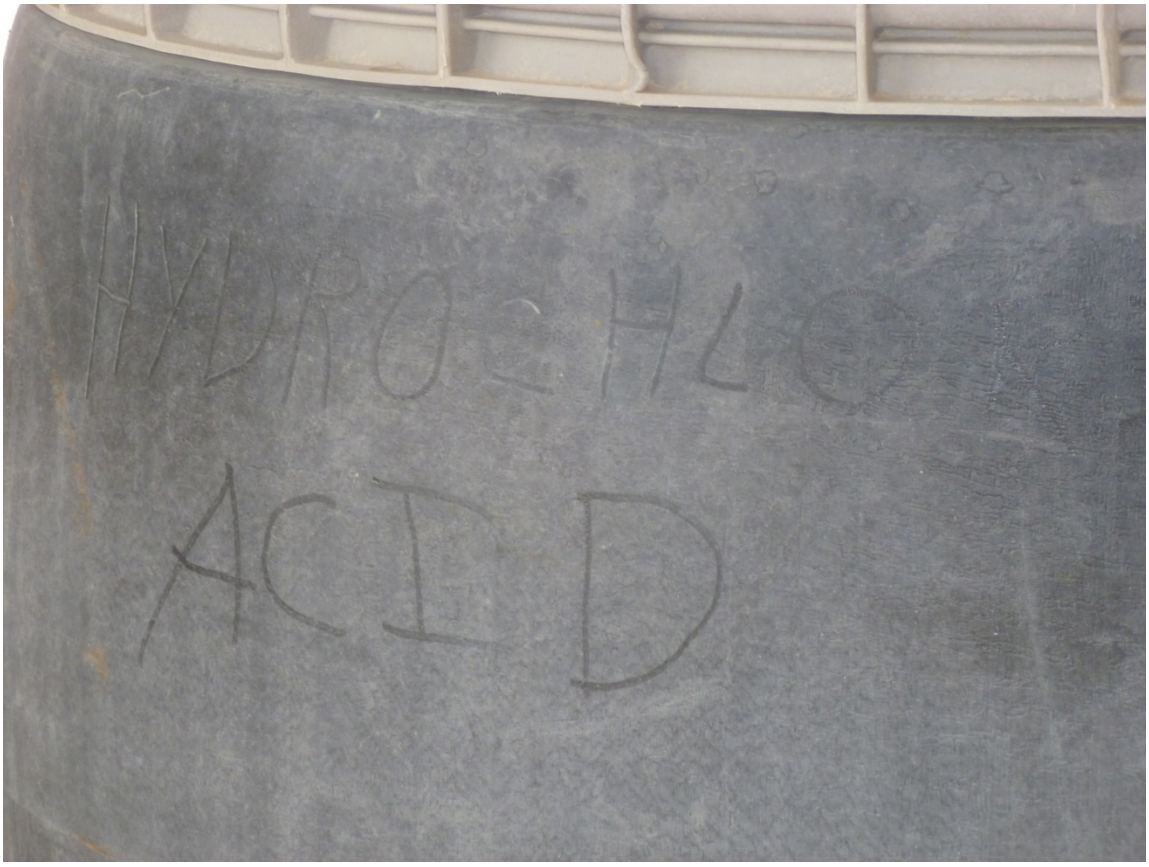

Figure 4-4. Improperly Collocated Hydrochloric Acid Drum with Hand-Etched Label

Section 4.1.2 of OP-B725.001 requires that chemical storage at NPTEC meet the storage requirements stipulated in the MSDS. Contrary to these requirements, the Motel storage facilities at the NPTEC are outdoor chemical storage sites with minimal protection from direct sunlight. Temperatures at this site can reach 120°F in the summer months and freezing temperatures in the winter. The storage conditions at the "Motel" storage facilities at NPTEC are inappropriate for most chemicals. The high temperatures present at these sites could promote peroxide formation in the isopropyl alcohol stored there, likely leading to higher concentrations over a shorter time period than would be expected under recommended storage conditions. Even characteristically stable chemical compounds would be expected to degrade appreciably when stored under these conditions for long periods of time.

Current information exists in the form of MSDSs and scientific literature that describes the conditions for safe storage of peroxide-forming chemicals. Essentially, peroxide formers should be dated upon receipt, again dated upon opening, and stored away from heat and light with tight-fitting lids to minimize oxidation. These conditions were not met at NPTEC. Chemicals in the West Motel bays were stored

outdoors and exposed to elevated temperatures. The IPA drums were vented to atmosphere, enabling spontaneous formation of organic peroxides by a free-radical reaction of the hydrocarbon with molecular oxygen in the process of autoxidation. Evaporation over long periods of time allowed concentration of the contents. The lid was left off the event drum two days prior to the accident, further accelerating concentration. These storage conditions enabled the formation and accumulation of organic peroxides that could explode violently when subjected to thermal or mechanical shock. Some MSDSs specify that these compounds should not be stored for longer than 12 months after opening unless a suitable test demonstrates they have not accumulated peroxide.

4.5 Hazard Control

Periodic IH HHEs are conducted in accordance with OP-P450.018, "Industrial Hygiene Health Hazard Evaluations, Assessments, and Reports," to confirm the effectiveness of implemented controls. Industrial Hygiene previously assigned a "Low" Workplace Category to the facility, requiring assessment every 60 months. The categorization was based on IH's interpretation of the criteria listed in Appendix A, "Health Hazard Evaluation (HHE) Categorization and Surveillance Frequency." Building T00014 (West Motel) was viewed as a (not normally occupied) storage facility, with only negligible sources of health risks present. The assumption was that, if chemicals are stored in proper containers, it should be a low hazard to move them. The additional IH assumption supporting the low category is that the high hazard at NPTEC was associated with the spill/release program that is addressed by activity-specific job hazard analyses and work packages.

In the Board's estimation, the criteria in OP-P450.018, Appendix A, are unclear and open to subjective interpretation. However, reasonable application of the associated criteria (i.e., industrial environment with some inherent sources of health risks present and relatively low hazard potential, and hazards well defined and controlled) places the West Motel in the "Medium" Workplace Category requiring assessment every 36 months. The non-conservative rating of "Low" was incorrect because hazardous chemical transfers are performed at the site. The potential for exposure and toxic inhalation exists. In addition, it is always possible to puncture a container and create a spill. The presence of spill mitigation equipment (e.g., acid neutralizers) demonstrates that the facility operators consider this a viable possibility.

The intent of the periodic HHE is to provide information on new processes, or changes in ongoing processes, and to document/evaluate the effectiveness of existing control measures. Findings of other evaluations or consultations made during the specified period are summarized. By procedure, sampling may not be required for the periodic HHE, and if no sampling is required in the exposure-monitoring plan and there are no additional processes or significant changes to existing processes, a walkthrough evaluation documenting these findings is adequate.

The most recent periodic HHE for the West Motel was completed on May 21, 2014, with the associated report issued on June 2, 2014. This report reaffirmed the earlier Low Workplace Category and did not identify any deficiencies with conditions at the West Motel even though chemicals were overdue for removal and required labels were missing. Follow-on information developed by the Board confirmed that a rigorous HHE had not been performed, and the review that was performed was not documented according to procedure.

4.6 Waste Minimization and Disposition

With respect to hazardous waste, OP-B725.001 requires the Facility Owner or representative to determine the appropriate waste disposal method for empty hazardous material containers by consulting with the Solid Waste Operations group. NPTEC hazardous wastes and containers are

handled in accordance with CD-P270.010, "Waste Management." This directive was superseded and replaced by CD-P410.010, "Waste Management," in August 2011. Based on the latest directive, the Facility Manager is directed to contact Waste Generator Services for assistance with characterizing and/or disposing of hazardous waste in accordance with CD-P410.014, "Hazardous Waste Accumulation," or successor document. This company directive assigns responsibilities, states requirements, and describes the method for establishing, operating, and deactivating satellite accumulation areas (SAAs), universal waste collection centers (UWCCs), and 90-day accumulation areas (90-day AAs) at specified NSTec operations. None of the directives provide the level of detail expected to ensure the chemical working inventory and residual waste is managed effectively in accordance with best practices.

In addition to the company-level CSLM criteria addressed in this functional area, this Board has found that a Chemical Hygiene Plan (CHP), developed in accordance with 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories," can provide considerable value at the facility level. A CHP is commonly developed when chemical manipulations are carried out on a "laboratory scale," multiple chemical procedures or chemicals are used at the facility, procedures involved may not be part of a production process, and protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Based on interviews held with facility staff, it was previously determined that NPTEC activities do not meet the criteria for development of a CHP. However, a CHP process commonly provides considerable value and is viewed by numerous companies as a best management practice to further enhance their management and implementation of chemical safety processes.

CON 4 **NSTec has not developed a corporate-level program to ensure all aspects of chemical safety and lifecycle management are integrated and consistently addressed at the facility level.**

CON 5 **NSTec does not have a Chemical Safety AHJ, or equivalent individual, responsible for enforcing chemical safety requirements.**

CON 6 **There were no provisions to confirm at any periodicity that the most recent MSDS (incorporating current chemical hazard information) is available for use at NPTEC.**

CON 7 **The NPTEC MSDS Index was not developed or maintained in accordance with the NSTec HAZCOM company directive.**

CON 8 **The NPTEC hazardous materials management procedure did not institute adequate procurement controls to minimize chemical-related hazards.**

CON 9 **NSTec has not implemented an automated chemical tracking system to provide real-time (dynamic) inventory management of chemicals in all facilities.**

CON 10 **No evidence exists in the form of tests or inspections to demonstrate that the minimum functional capabilities of the NPTEC grounding systems were met to ensure safe operations.**

CON 11 **The NPTEC West Motel is not an "approved flammable liquid storage room," as required by CD-P280.029.**

CON 12 **Containers used for storing hazardous chemicals at NPTEC were not labeled as required (i.e., chemical identification and appropriate hazard warnings).**

CON 13 **Incompatible chemicals were not stored separately as required to prevent contact in the event of an accident.**

CON 14 **HHEs performed at NPTEC did not appropriately categorize the facility and did not identify improper storage of chemicals.**

CON 15 **NPTEC has not implemented a documented process that identifies, in a timely manner, excess chemicals and appropriate protocols for reuse, recycle, or disposal.**

CON 16 **NSTec has not developed a CHP for NPTEC.**

JON 4 **NSTec needs to establish procurement controls that that enable just-in-time contracts and ensure only the minimum amounts of chemicals needed to perform planned work are ordered.**

JON 5 **NSTec needs to consider implementing an effective hazardous waste management plan.**

JON 6 **NSTec needs to consider implementing an automated tracking system that will enable real-time (dynamic) inventory management of chemicals in all facilities.**

JON 7 **NSTec needs to consider establishment of a single "corporate approved" MSDS for all chemicals, including a mandatory review periodicity (e.g., annually).**

JON 8 **NSTec needs to examine options to enhance performance of HHEs.**

JON 9 **NSTec needs to consider implementing a comprehensive CSLM Program that ensures all aspects of chemical safety and management are integrated and consistently addressed at the facility level.**

JON 10 **NSTec needs to consider development and implementation of CHPs for selected facilities, including NPTEC.**

JON 11 **NPTEC needs to ensure chemicals are appropriately stored in accordance with governing NSTec requirements and MSDS criteria.**

5.0 CONDUCT OF OPERATIONS

Ideal State

Conduct of Operations (CONOPS) is an overall methodology for achieving safety, security, and efficiency in the operation of DOE facilities. Contractors utilize the principles of Integrated Safety Management and Integrated Safeguards and Security Management, which are implemented in accordance with DOE O 422.1, "Conduct of Operations."

As Found Conditions:

NSTec utilizes a systematic graded approach in determining applicability of CONOPS requirements. This approach ensures that the depth of detail required and the magnitude of resources expended for operations are commensurate with each facility's programmatic importance and potential impact on the health and safety of employees, the public, and the environment. These requirements are captured in CD-NOPS.024, "Conduct of Operations Requirements." This directive provides the CONOPS requirements in accordance with DOE O 422.1 and NSTec Company Policy PY-NOPS.002, "Formality in the Workplace," at facilities managed by NSTec.

The supporting NSTec documents include procedures for Organization and Administration, Shift Routines and Operating Practices, Communications, On-Shift Training, Investigations of Abnormal Events, Conditions and Trends, Notifications, Control of Equipment and System Status, Logkeeping, Independent Verification, and Component Labeling, as required by DOE O 422.1.

NNSA/NFO generated a letter entitled "Technical Direction to Implement DOE O 422.1, Conduct of Operations," dated May 2, 2011. This letter provided dates for developing a CONOPS Matrix to the revised DOE O 422.1 for all nuclear and various non-nuclear facilities. The Revised CONOPS Matrix for NPTEC was submitted to NNSA/NFO for approval on March 9, 2012, and approved on April 3, 2012. Based upon a review of the NSTec CONOPS Program, the Board identified the challenges discussed later in this section. Due to the commonality of CONOPS with other functional areas, some CONOPS topics are addressed elsewhere in this report.

In addition, NNSA/NFO generated a letter entitled "Technical Direction to Develop a Formal Process for Determination of Conduct of Operations Applicability for Non-Nuclear Facilities," dated December 30, 2013. This letter provided direction to NSTec to develop a formal process that evaluates and provides formal recommendations for designating "accelerator, explosives, laser, nanotechnology, biohazard, chemical, or other facilities" to allow the NNSA/NFO Manager to maintain consistency of CONOPS applicability across the Nevada Enterprise.

Based on the NNSA/NFO Technical Direction letter, NSTec revised CD-NOPS.005, including Appendix B, "High Hazard Conduct of Operations Applicability Matrix Template," and Appendix C, "Moderate Hazard Conduct of Operations Applicability Matrix Template," both of which contain the specific requirements and attributes for High Hazard and Moderate Hazard areas. These templates list CCDs, CDs, and other documents that fully satisfy the requirements and attributes as an implementing document, or fully satisfy the requirements and attributes when multiple implementing documents are identified. CD-NOPS.005 utilizes a graded approach for non-nuclear facilities to implement the requirements of DOE O 422.1. Interviews conducted by the Board identified that NSTec has stopped using the terminology Conduct of Operations for non-nuclear facilities and revised the directive using the new terminology "Formality in the Workplace." This is based on the perception of NSTec staff that using the terminology of Conduct of Operations implies meeting the requirements of a nuclear facility.

SEP-B725-00, Section 1.1, "Scope of Work," requires development of a long-range staffing plan when major new capabilities are added and limited staffing and base operations budget are anticipated. This Board was not provided with copies of such staffing plans, and the SEP does not identify personnel resources required to accomplish operational activities. Interviews conducted with workers and line management indicated that personnel were not aware of the existence of a current staffing plan. Many comments were made that reductions in staffing due to budgetary issues have many personnel supporting multiple NSTec facilities. While this allows other Directorships in the NSTec organization to provide resources to support operational activities, additional strain may be introduced regarding balancing priorities, maintaining situational awareness of facility infrastructure considerations, etc. Since NOD has taken over NPTEC, SEP-S521-04, "NSTec Support Execution Plan (SEP) for High Hazard Facilities," has been developed. However, this SEP also fails to identify personnel resources to support operational activities.

A review of NSTec self-assessments performed in the past two years identified various CONOPS issues with almost all issues being extended out for many years or put on hold due to funding. In numerous instances, issues were assigned a Priority Level 4. Other issues identified are discussed in more detail under Section 9.0 of this report. Interviews with workers indicated that there is reluctance to document operating problems using the NSTec Issues Management process because "nothing ever changes." (Refer to Sections 9.0 and 12.0 for additional discussion.)

An interview was conducted with NSTec line management that identified management assessments have not been conducted by NSTec for Configuration Management implementation at non-nuclear facilities. This is due to non-nuclear facilities not being on NSTec's radar, mostly because focus is on nuclear facilities. The Board noted that CD-ENGR.002, "Configuration Management," can be applied to non-nuclear facilities on a graded approach, at the Facility Manager's discretion, and also that the approved CONOPS Matrix identifies this NSTec directive as an implementing document for Component Labeling, an element of the approved CONOPS Matrix. OP-B725.012, "Nonproliferation Test and Evaluation Complex (NPTEC) Configuration Management," was developed and effective April 25, 2011. This directive was cancelled on March 14, 2013, due to not being a NOD procedure, but has not been replaced by any directive that provides equivalent expectations.

NPTEC has an elaborate Process Control System that monitors equipment operation and system status from the control room located in Building 5-08. For many of the release systems used at NPTEC, chemical systems can be pressurized and chemical flow can be initiated and controlled from the control room. Status indicators for temperature, pressure, valve position, and weight (for many systems) are displayed in real time for the control room operator. NSTec utilizes CCD-QA05.001, "NSTec Integrated Work Control Process," and CCD-QA05.001-005, "Work Package Process," to implement the requirements of Control of Equipment and System Status.

The facility has multiple cameras that are positioned around the facility to provide visual records of experiment activities. The cameras historically were used when work of a hazardous nature was being performed to provide a record in the event that an incident occurred. Upon asking for video surveillance data for the accident under investigation and for the chemical transfer that occurred on the Wednesday prior to the accident, this Board was advised that three out of five cameras have been unusable for at least three years and not repaired. There is only one working camera that has a view of the West Motel. However, because this camera is located approximately three-quarters of a mile away, it cannot provide adequate footage of work activities at the West Motel. As a result, no video was captured of work activities performed in Bay 30, or of the explosion that resulted in significant personnel injury.

The Process Control System in the control room logs chemical activities for the system. Flow rates, weights, temperatures, pressures, as well as every time an automatic valve is opened and closed, are

all logged in the process control system and can be presented in a report format. Chemical release flow rates and often start and end weights are logged by the system so that quantities of chemicals used can be easily tracked and verified. This is documented in the Test Director's Checklists for each day of an activity. The facility also has multiple weather data mechanisms that are logged and displayed. These systems provide weather information for plume modelling and early warning mechanisms for storms. The site lightning alert system is also monitored in the control room.

The approved NSTec CONOPS matrix for NPTEC dated February 6, 2012, identifies that logkeeping is not applicable, with the following justification provided: "NPTEC does not maintain operational logs due to the work package process documentation and test/project data being electronically recorded." This is not consistent with CD-NOPS.024-004, "Logkeeping." This directive notes that NSTec does not presently have a companywide DOE-approved and certified electronic storage system; therefore, retention of paper copies of all electronic data is required. Electronic logs may be used, provided the facility develops a logkeeping directive to meet the requirements of DOE O 422.1. Based on these requirements, NPTEC has not developed its own logkeeping directive when logs are being generated for operational activities, and the NPTEC CONOPS matrix was approved with this non-applicable element of CONOPS.

Interviews conducted by this Board with line management and facility personnel indicated one individual as believing that he was the Authorized Facility Manager for the day and at the time of the accident. However, such a title is not addressed within the organization, there is no formal delegation. Other interviews had also identified an NSTec Project Manager (PM) for this facility during the operations being conducted at the time of the accident. When this individual was being interviewed by the Board, it was documented that this individual was not the project manager during this operation and the project manager role had been reassigned to another individual. (Refer to Section 10.0 for additional discussion.) It is the opinion of this Board that NPTEC staff does not understand who has what authority, which creates overlap and gaps often resulting in no concurrence on authorizations or the wrong concurrence to match the responsibility. Many concurrences or authorizations were given verbally by whoever is believed to be responsible.

Based upon a series of interviews with NSTec and NNSA/NFO personnel, concerns were identified with labeling of chemicals and logkeeping of current chemicals on site. The Approved CONOPS Matrix states that it will use CD-ENGR.006, "Numbering and Labeling of Structures, Systems, and Components (SSC)," and CD-ENGR.002 to implement the requirements of DOE O 422.1 for component labeling. CD-ENGR.006 has been superseded by CD-SENG.003, "Numbering and Labeling of Structures, Systems and Components (SSC)." This directive is applicable to all facilities at the NNSS, and its Appendix C, "Components Recommended for Numbering and Labeling," identifies storage containers, cabinets, and storage spaces to be numbered and labeled. This concern has been identified various times by NSTec, with limited, if any, corrective actions being taken to resolve these concerns.

By way of example, NSTec CONOPS Management Assessment MA-12-S100-007-NPTEC was conducted in March of 2012 assessing implementation of equipment piping and labeling. The results of this assessment generated Issue #21001 in caWeb, NSTec's companywide issues tracking system, which states: "During interviews, the FM and AFM confirmed that a method to help ensure the prompt identification and correction of labeling deficiencies has not been established." The NSTec directive in place at the time (CD-ENGR.006) provided a series of considerations for labeling. Examples included obtaining Manager/Supervisor approval of temporary and/or replacement label(s) prior to installation; inspecting for missing or damaged labels during normal tours and during other routine activities; reporting missing labels to supervision; and verifying that replacement permanent labels are installed in

accordance with facility procedures. (Note: As discussed above, CD-ENGR.006 has been superseded by CD-SENG.003, effective November 11, 2013.)

This caWeb issue was closed out on May 21, 2013, and the documentation listed to close out the issue was NSTec Standard Operating Procedure SOP-HHF.002, "High Hazard Facilities Explosive Packaging and Repackaging," along with Form FRM-2492, "Facility Work Inspection." Upon review of the closure documentation, SOP-HHF.002 does not reference the use of CD-SENG.003. FRM-2492 does address checking of chemical labeling but does not reference use of CD-SENG.003. Therefore, it is the opinion of this Board that this disposition does not adequately address closure of the issue and this closure evidence does not adequately address how NPTEC is implementing the requirements of the approved NPTEC CONOPS Matrix for Component Labeling.

The Board has reviewed various NSTec active procedures in which many cases of incorrect and outdated references exist. The following are examples of these inconsistencies.

At the facility level, the currently approved procedure OP-B725.001 is implemented "to supplement company directive CD-P280.020, 'Selecting, Using, and Storing Chemicals.'" However, CD-P280.020 is no longer an active document, as it was superseded by CD-P450.012, "Hazardous Chemical Use and Storage," in June 2011. Subsequently, CD-P450.012 was superseded by the current company directive CD-P450.008, "Hazard Communication and Hazardous Substances Use and Storage," in October 2013. OP-B725.013, "Nonproliferation Test and Evaluation Complex (NPTEC) Configuration Management," was cancelled in March of 2013 and is referenced in various NSTec documents. Also, as discussed earlier, CD-ENGR.006 has been superseded by CD-SENG.003. The Board identified several other cases where change control has not been adequately maintained to ensure that facility-level procedures accurately reflect currently approved company directives.

CON 17 **The Board determined that while the NPTEC CONOPS program is well defined in the associated CONOPS Implementation Matrix, it has not been effectively implemented.**

CON 18 **Staffing plans were not produced and technical support line management was unable to state what was considered "minimum staffing" for safe operations.**

CON 19 **Configuration Management has not been formally assessed by NSTec for non-nuclear facilities.**

CON 20 **Impact of out-of-service cameras was not recognized.**

CON 21 **Logkeeping and turnover of duties and responsibilities are not being conducted in accordance with company requirements.**

CON 22 **Facility-level procedures do not accurately reflect currently approved company directives.**

CON 23 **GS and NOD management promoted the concept of "Formality in the Workplace," in lieu of "Conduct of Operations," thereby diluting the importance of a long-standing overall philosophy for achieving excellence in the operation of DOE facilities.**

JON 12 **NSTec needs to ensure that a comprehensive CONOPS program is effectively implemented for all NPTEC activities in a tailored manner versus attempting to implement a Formality of Operations process.**

JON 13 **NSTec needs to ensure that facility equipment required to support project activities (e.g., cameras) is effectively maintained whereby it can perform its intended function.**

JON 14 **NSTec needs to conduct an Extent of Condition review of other NSTec facilities implementing the DOE CONOPS program.**

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6.0 EMERGENCY MANAGEMENT

Ideal State

Each DOE facility/site or activity is required by DOE O 151.1C, "Comprehensive Emergency Management System," to have an Operational Emergency Base Program, which provides the framework for response to serious events or conditions that involve the health and safety of workers and the public, the environment, and safeguards and security. Although DOE O 151.1C establishes several DOE-unique requirements and a minimum set of generic requirements for the Base Program, the framework for response results mainly from the implementation of the requirements of DOE regulations, other DOE orders, and applicable non-DOE federal, tribal, state, and local laws/regulations/ordinances. The specific requirements that constitute the Operational Emergency Base Program are the emergency planning and preparedness aspects of these orders and laws/regulations/ordinances. Examples of emergency response features addressed in other DOE orders and laws/regulations/ordinances include medical support, worker evacuation plans, fire drills, worker notification systems, hazardous material communication, contingency planning for oil spills, environmental spill drills and exercises, and DOE safeguards and security requirements. The objective of the Base Program is to achieve an effective integration of emergency planning and preparedness requirements into an emergency management program that provides capabilities for all-emergency response, through communication, coordination, and an efficient and effective use of resources.

The Hazards Survey, which is required by DOE O 151.1C for each facility/site or activity, is used to identify the generic emergency events or conditions that define the scope of the emergency management program. The Hazards Survey is a qualitative examination of the events or conditions specific to the facility/site or activity that may require an emergency response. The description of the potential impacts of such events or conditions (natural phenomena, wild land fires, hazardous materials releases, malevolent events, etc.) contained in the Hazards Survey determines the planning and preparedness requirements that apply. These requirements constitute the Base Program. The Hazards Survey is the formal mechanism used to determine the scope and extent of the facility/site or activity Base Program. If hazardous materials are not present at the facility/site or activity, or are present in quantities less than quantities that are "easily and safely manipulated by one person" (i.e., threshold screening quantities), then the Base Program appropriately defines the facility/site or activity emergency management program that meets the requirements of DOE O 151.1C.

Because of the myriad forms and quantities of hazardous materials in use throughout DOE/NNSA facilities and activities, the Comprehensive Emergency Management System provides the opportunity to use a screening process to reduce the number of hazardous materials quantitatively analyzed for emergency planning purposes. Use of the screening process is not intended to avoid analyses of hazardous materials that have the potential to harm workers or the public, but to allow emergency management resources to be focused on analyzing materials that, because of their quantity, toxicity, and dispersibility, have the potential to harm people who are outside the immediate workplace where the materials are used or stored. The hazardous material screening process identifies inventories of specific materials in a facility/site or activity whose release could cause a hazard significant enough to warrant specific consideration in an Operational Emergency Hazardous Material Program.

The screening process includes qualitative criteria that are used to determine if hazardous materials screen out from further quantitative analysis in an Emergency Planning Hazards Assessment (EPHA). The screening results are documented in the facility Emergency Planning Hazards Survey (EPHS). While hazardous materials might be screened out from further analysis in the EPHA, the possibility that the excluded materials could initiate, through fires or explosions, the release of other hazardous materials must be considered. Although fires and explosions are the most obvious examples, the

release of other hazardous materials (e.g., materials with health hazard rating <3) that could cause temporary incapacitation of workers resulting in a process upset that releases a material with a National Fire Protection Association (NFPA) health hazard rating ≥3 or 4 should be considered in the screening analysis. The release of a material with a health hazard rating that in large quantities could pose an asphyxiation hazard to collocated workers should also be considered in the analysis.

DOE O 151.1C requires a quantitative hazards assessment if the hazards survey screening process identifies specific hazardous materials and quantities that could produce impacts consistent with the definition of an Operational Emergency. In general, an Operational Emergency involving an uncontrolled release of a hazardous material must immediately threaten or endanger those in close proximity of the event; have the potential for dispersal beyond the immediate vicinity of the release in quantities that threaten the health of onsite personnel or the public in collocated facilities, activities, and/or offsite; and have a potential rate of dispersal sufficient to require a time-urgent response to implement protective actions for workers and the public.

An EPHA is a quantitative analysis that includes the identification and characterization of hazardous materials specific to a facility/site or activity, analyses of potential accidents or events, and evaluation of potential consequences. The results of the EPHA determine whether an Operational Emergency Hazardous Material Program is required. If the analysis results associated with a facility/site indicate the potential for an Alert, Site Area Emergency, or General Emergency (as defined in DOE O 151.1C), then a Hazardous Material Program is required; the analysis results will also provide the technical planning basis for the hazardous materials emergency management program. The Base Program, described above, provides the “base” or “foundation” for the Hazardous Material Program. The emergency management program that results from the “seamless” integration and coordination of these sets of requirements (“base” plus hazardous materials) becomes the emergency management program for the facility/site or activity.

Not every conceivable situation can be analyzed and, hence, not every response can be preplanned. However, the development of an adequate Hazards Survey and EPHA, in combination with effective and integrated emergency planning and preparedness, provides the framework for response to any emergency event or condition.

Using the knowledge and insights gained through the Hazards Survey and EPHA processes, a DOE facility/site or activity emergency management organization should develop detailed plans and procedures and train the staff to carry out response actions, in particular, to reduce the severity of hazardous material release events and to minimize health impacts. The emergency management program for a facility/site or activity with hazardous materials will typically include the following measures for the most effective response to releases:

- Mobilization of response assets
- Rapid warning and notification of affected population
- Planned (predetermined) protective actions
- Pre-positioned equipment and supplies
- Provisions for personnel decontamination and medical intervention

The emergency management program for a facility/site or activity should include the following measures to provide assurances of an effective response to hazardous material releases:

- **Structured training/drills program**. A comprehensive, coordinated, and documented program of training and drills is an integral part of the emergency management program to ensure that preparedness activities for developing and maintaining program-specific emergency response capabilities are accomplished.

- **Formal exercise program**. A formal and focused exercise program should validate all elements of the emergency management program over a multi-year period through a formal exercise program. Facility- and site-level emergency management program elements are validated by initiating response to simulated, realistic emergency events/conditions in a manner that replicates an integrated emergency response to an actual event as nearly as possible. Lessons Learned are developed, resulting in corrective actions and improvements.
- **Continuous program improvement**. A readiness assurance program provides a framework and associated mechanisms to ensure that emergency plans, implementing procedures, and resources are adequate and sufficiently maintained, exercised, and evaluated, and that appropriate, timely improvements are made in response to needs identified through coordinated and comprehensive emergency planning, resource allocation, training and drills, exercises, and evaluations.

NPTEC Emergency Plan Implementing Procedure NPTEC-EPIP-01, "Facility Emergency Response Actions," provides NPTEC emergency response organization (ERO) members with the actions required to be taken in the event of an emergency at NPTEC. These actions include making necessary emergency notifications; categorizing and classifying emergency events in conjunction with pre-determined facility-specific emergency action levels (EALs); determining and implementing the most appropriate protective actions for personnel at NPTEC facilities/locations; establishing a Facility Command Post from which to manage the initial on-scene response; performing assembly, accountability, sheltering, and evacuation of personnel in response to an emergency; and identifying the emergency equipment necessary for emergency operations.

The NPTEC LED is required to assess the situation and make initial notifications as follows: notify personnel in the area to initiate protective actions; activate emergency action team members; call 9-1-1 OCC Fire Dispatch to request assistance (if necessary); call the OCC Duty Manager (DM) to initiate notification and reporting; and call WSI-Nevada Central Alarm Station (CAS) and provide event information. In addition, the LED is required to obtain the LED Emergency Response binder with checklists, procedures, and EALs as references.

The LED is also required to review pre-determined facility-specific EALs and determine if the event requires categorization and classification (as applicable), and make those decisions based on the applicable EAL. If the event is declared or has the potential to be declared as an Operational Emergency, then they must also notify the OCC DM and discuss categorization/classification of the emergency.

Upon receipt of an initial notification of an emergency, the OCC DM and Operations Support Specialist follow the steps in the OCC Consolidated Notification Checklist, and when necessary, in conjunction with this checklist, use desktop instructions and other checklists.

For High Hazard Facilities such as NPTEC, the OCC DM is required to review the Initial Response Guide (IRG) to assist the LED in determining event categorization and classification, if necessary. If the LED for a High Hazard Facility is unavailable or unable to categorize and classify the emergency, then the OCC DM determines categorization and classification.

Once OCC Fire Dispatch receives a 9-1-1 call reporting an incident, and obtains initial information from the caller as outlined in OP-2120.042, "Operations Coordination Center Fire Dispatch Operations," the OCC Fire Dispatcher will dispatch, based on the emergency situation, the appropriate F&R personnel and vehicles over both Command 1A radio and Fire Stations public address systems located in Fire Station 1 and Fire Station 2. Additional notifications are made by the OCC, including activating the 5001

ring-down line, which simultaneously notifies NNSS Occupational Medicine, WSI-Nevada CAS, the Nye County Sheriff's Office (NCSO) in Mercury, and the EOC. Information about the emergency is provided and, if necessary, requests to respond are made.

When F&R crews are en route to the incident, the Assistant Chief (Incident Commander or IC) will acquire as much information as possible from the Fire Dispatcher, the Pre-Incident Plan, and LED by ERO-14 or phone, asking for known conditions; number of victims and status; combustible materials, chemicals, radioactive materials; current prevailing wind and weather data; facility status, operational status of the facility, and whether protective actions have been taken, etc. The IC will communicate over Command 1A mobile radio to all responding vehicles to approach the facility, if possible, in an upwind position when smoke is showing or potential release of hazardous materials is present. The LED is also required to ensure emergency responders are aware of all developing hazards and direct them to the most appropriate entry point based on the event conditions.

The first arriving fire officer will perform and report an initial size-up in accordance with OP-2120.072, "Incident Size-up," and establish a UIC in accordance with Desktop Instruction IC-02, "Unified Incident Command Interface." During a non-security emergency, the senior NNSS F&R officer becomes the Lead IC; directs all emergency response activities at the emergency scene from the Incident Command Post; develops and implements an oral or written incident action plan with the support of WSI-Nevada, NNSS F&R, laboratories, local law enforcement, and the LED, who provides technical and management support to the IC; and maintains ongoing communication with the EOC (if operational).

If needed, a call-back of off-duty F&R personnel will be conducted to back-fill at fire stations to maintain response capability for the NNSS. The IC may make additional requests for mutual aid resources if necessary, such as additional ambulances, air ambulance helicopters, or other support from offsite responders to include LVMPD ARMOR, Creech Air Force Fire Department, Nye County Emergency Services, Mercy Air, or Tri-State Care Flight, etc.

Each incident is different and may require the use of a small part of a National Incident Management System or the entire concept. The IC will build a command structure matching the organizational needs of the incident, achieving the strategic goals and tactical objectives, and assessing the following incident priorities in their respective order:

1. Life safety issues for all F&R personnel, other emergency workers, occupants, and bystanders at an incident
2. Incident stabilization strategy that will minimize the impact of any incident on the surrounding area and the NNSS as a whole
3. Property conservation to achieve the above-stated goals and objectives at an incident while minimizing property damage or loss

Termination of command can occur when the incident is mitigated or no further action is being taken.

For nonoperational emergencies, the IC may terminate command by notifying OCC Fire Dispatch that "the command is terminated," and inform all F&R crews of command termination and to demobilize. For operational emergencies, the IC may recommend termination of command to the Emergency Manager at the EOC. When the EOC recommends termination, the LED assists with the recovery planning and termination process. Upon termination of the emergency, the LED transitions into recovery operations.

As Found Condition: Emergency Planning and Preparedness

NPTEC emergency planning documents that perform an analysis on hazardous materials include EPHS-1024, "Emergency Planning Hazards Survey, Area 5 Nonproliferation Test and Evaluation Complex," and EPHA-1003, "Emergency Planning Hazards Assessment for Nonproliferation Test and Evaluation Complex." The results of the screening process for NPTEC hazardous materials are documented in the EPHS. The screening process determined that IPA was screened out from further quantitative analysis in the EPHA. Therefore, there was no requirement to carry over the IPA for further analysis in the EPHA. The EPHA includes a section on initiating events, to include accidents such as fires, explosions, interaction of reactive materials, and process upsets, but does not consider which chemicals, while screened out from analysis, may be possible initiators or promoters of a release (for example, due to their combustible, explosive, or corrosive properties) of other toxic substances. The initiator may also be key to recognition of an actual or potential release.

As Found Condition: Response (Facility level)

The NPTEC employee identified on the Plan of the Day to fill the role of the LED during an emergency was out in the field at the Area 5 NPTEC facility at the time of the event. Upon being notified of the event by one of the employees at the event scene, the NPTEC employee designated as the LED assumed the role of the LED and reported to the event scene. The LED began to make the initial notifications by contacting the OCC and verifying that F&R were on their way. Several minutes later, the OCC DM contacted the LED to review information he had been hearing over the radio. The DM verified with the LED that they had an occupational injury and not a categorization/classification situation, with which the LED concurred. The LED proceeded to inform the DM that they had an empty barrel that contained IPA that ruptured due to fumes in the barrel. They discussed the barrel size as 55 gallons and the fact that the drum over-pressurized and that one person received a laceration on his leg. The LED proceeded to inform the DM that there was no hazard and no reason for additional concern.

With respect to the categorization/classification decision, neither the LED nor the DM followed their processes or training to make that decision. The LED was in the field at the time and did not have his procedures, checklist, or NNSS IRG, which would have allowed him to make his decision. An interview with the LED revealed that he made his decision based on fact that all material was gone in the over-pressurization and nothing was left of it. An interview with the DM revealed that he used the IRG and U.S. Department of Transportation 2012 Emergency Response Guidebook (ERG) to make his decision. He stated that, with the ERG, it is easier to look up a chemical than with the IRG, so he used the ERG. The ERG is used for transportation events, not events that occur at fixed facilities such as NPTEC. The LED and DM are expected to walk through the categorization/classification decision-making process to determine if they come to the same conclusion. The LED did not inform the DM that he did not have his procedures, checklist, or IRG with him when he made his decision, so the DM was unaware how the LED came to his conclusion.

As Found Condition: Response (F&R)

The NPTEC worker reporting the incident to the 9-1-1 operator relayed basic information about the event, including a drum explosion and one injured worker (laceration). This call was placed on a cell phone from the incident scene, and due to the automated system routing all cell phone emergency calls to the offsite Nye County Sheriff's Office (either Beatty or Pahrump), direct contact by the OCC Fire Dispatcher to the reporting person did not occur. The offsite Nye County Sheriff's Dispatcher did not forward the caller to the OCC and simply relayed the information about the drum explosion and single injury along with the caller's first name and telephone number. It would have been helpful for the OCC Fire Dispatcher to communicate directly with the caller initially to gather additional incident information

and provide pre-arrival medical treatment instructions. OCC Fire Dispatch attempted to contact the reporting person via the call-back number provided by the Nye County 9-1-1 dispatcher; however, they were unable to establish contact (unknown reason). According to the OCC Department Manager, no formal agreement exists between the NCSO (9-1-1 dispatch function) and the NSTec OCC to ensure that 9-1-1 callers are transferred. A verbal hand-shake agreement is all that is in place to transfer callers into the OCC from the NCSO dispatch center.

The OCC Duty Manager activated the 5001 ring-down line approximately 1 minute after receipt of the call by OCC Fire Dispatch. The ring-down line connects with several organizations during regular duty hours; however, during weekends and backshifts, the WSI-Nevada CAS is the only group on the 5001 line. The CAS is responsible for notifying the onsite Nye County Sheriff's Deputies in the event of an incident on or off the NNSS. The Nye County Sheriff becomes part of the UIC structure and coordinates law enforcement and crime scene investigation activities. Although the WSI-Nevada CAS received the initial report of the incident via the 5001 ring-down line at approximately 0853, the Nye County Sheriff's Incident Report number IR 14-M050 documented that their dispatch time was approximately 0924. The WSI-Nevada Lieutenant's Irregularity Report number 14-172 documented a notification time of 0852 by the CAS to WSI-Nevada response resources. The delay in notification to the Nye County Sheriff's Deputy is not consistent with expectations between WSI-Nevada and the NCSO.

During the emergency tone-out by OCC Fire Dispatch to F&R Stations 1 and 2 over the Public Address System, F&R personnel only heard the emergency tones. They did not hear the actual dispatcher initial incident information verbal report until coming up on the primary radio frequency (Command 1A). This caused the dispatcher to repeat the initial information a second time over the radio so all responding crews could understand the initial incident conditions.

The initial report by the 9-1-1 caller indicated a drum explosion with a single injury. The F&R responding Fire Officer began communicating with the LED on radio channel ERO-14 to gain current incident information as a follow-on to the 9-1-1 information relayed by OCC Fire Dispatch. This is in accordance with F&R Desktop Instruction IC-07, "F&R Communications Plan," and NPTEC-EPIP-01, Section 4.6. The 9-1-1 report indicated a drum explosion, and when the LED came up on radio channel ERO-14, he reported a simple drum over-pressure, no explosion or fire, and a laceration to the victim's lower leg. Also, he stated that the area was safe, with no chemical releases or exposures, and to meet him on the 5-03 road and he would lead them into the incident scene. The information provided by the LED was not completely accurate; when the F&R personnel arrived at the incident scene they determined that there was still a potential hazard with the remaining 55-gallon IPA drums, along with what appeared to be some residual liquid product on the ground near the damaged drum. Use of repeat-backs by the LED and the F&R Fire Officer was inconsistent on ERO-14 and may have led to some confusion regarding the patient's injury until arrival of the responders. The LED assumed the drum damage was a result of an over-pressure, when in fact the visual evidence was of a drum explosion (blown apart). The initial fire from the explosion singed the hair on the victim's forearms, head, and face, as well as shrapnel from the drum causing lacerations to the lower leg and foot. LEDs should report observations and not make assumptions unless information and facts support an accurate event evaluation.

After the patient was transported and the IC (F&R Assistant Fire Chief) evacuated all personnel out of the hazard area based upon remaining potential hazards, the command post was moved to the 05-08 building. With the condition of the involved drum and condition of grounding cables (corrosion on drum and cables), it was suggested that a possible cause was static discharge and ignition of residual alcohol vapors in the drum. The IC requested an accurate inventory of chemicals located in the West Motel area to evaluate hazards while planning incident mitigation actions. Obtaining an accurate inventory proved difficult, and without accurate up-to-date information, making manned re-entry to

determine the state of grounding cables, conditions of remaining drums, and identification of other chemicals in the vicinity would have been too risky. The IC requested robotic support from a mutual-aid organization (ARMOR) to allow unmanned entry for recon of the incident location.

CON 24 **NPTEC emergency planning documents do not clearly identify those hazardous materials that, while screened out from further analysis in the EPHA, may be considered initiators or promoters of a release of other toxic substances.**

CON 25 **The LED and DM decision-making process for the event categorization/ classification process was not consistent with their respective processes and training.**

CON 26 **The transfer of the 9-1-1 call from the Nye County Dispatcher to the OCC Fire Dispatcher was not consistent with the verbal agreement and expectations of the OCC Department Manager.**

CON 27 **The notification to the onsite Nye County Sheriff's Deputy by the WSI-Nevada CAS was not consistent with the Nye County Sheriff's Mercury Sub-Station Lieutenant's expectation of timeliness.**

CON 28 **The OCC Fire Dispatch Centracom link to the F&R Fire Station Public Address link did not operate as designed.**

CON 29 **The LED's initial assessment of the scene was not completely accurate, nor did he recognize the potential hazards remaining at the scene. Information provided by the LED to the OCC Duty Manager, Fire Dispatcher, and responders downplayed the actual incident conditions.**

CON 30 (POS) **F&R personnel continued scene assessment after arriving at the West Motel and, recognizing that there were still potential hazards, evacuated all personnel to a safe location.**

CON 31 **Although an inventory of chemicals housed in the West Motel structure was available, it was from March 2014 and the LED gave the impression that he could not confirm current inventory status. This deteriorated trust between the IC and facility SMEs.**

JON 15 **NSTec needs to evaluate its current screening process for identification of those hazardous substances that, while screened out from analysis in an EPHA, may be considered initiators or promoters of a release of those toxic substances analyzed in the EPHA.**

JON 16 **NSTec needs to evaluate its current process for documenting those hazardous substances that, while screened out from further analysis in the EPHA, may be considered initiators or promoters of a release of other toxic substances analyzed in the EPHA.**

JON 17	**NSTec needs to evaluate its categorization/classification process and training to ensure that personnel with categorization/classification decision-making responsibilities are following their respective processes and training.**
JON 18	**NSTec needs to evaluate establishing a more formal agreement with the Nye County Sheriff's Office to capture expectations for transferring NNSS-specific 9-1-1 call information.**
JON 19	**Nye County Sheriff's and WSI-Nevada's leadership need to evaluate current documentation (if any) requiring timely notification to Sheriff's Deputies by the CAS.**
JON 20	**NSTec Information Technology needs to evaluate the effectiveness of the Centracom to Public Address link in the OCC and Fire Stations 1 and 2.**
JON 21	**NSTec needs to evaluate whether current LED training is adequate to properly perform incident size-up, event recognition, and relay of critical incident information in a factual manner to emergency services personnel.**
JON 22	**F&R personnel need to be recognized for having a questioning attitude and evacuating all personnel out of the hazard area based upon remaining potential hazards.**
JON 23	**NSTec needs to evaluate the current method of configuration management in regards to chemical inventory, storage, compatibility, and use at the NPTEC Facility.**

7.0 ENVIRONMENTAL COMPLIANCE

Ideal State

NSTec operates in accordance with an Environmental Management System (EMS) that is certified under International Organization for Standardization (ISO) Standard 14001. This program is described in Program Description PD-0001.004, "Environmental Management System Description," and is implemented throughout the company. Integral to an EMS is a call for commitment to environmental protection and improvement at the highest management levels, and for thorough planning, assessing, and corrective actions. All work is supposed to receive an environmental review during the planning stage to determine the environmental aspects that could be affected by the work, and the level of environmental support needed. Mitigations are taken as necessary to lessen the impact and/or improve the company's environmental posture.

NSTec's EMS is carried out in four phases: planning work, performing work, checking performance, and improving these processes through management reviews. In Phase One, work is planned and environmental aspects and their impacts are identified in a hazard analysis required for work execution plans. Regulatory and other applicable requirements are also identified and implemented. In Phase Two, work is performed according to established operating constraints and regulatory requirements. In Phase Three, performance and compliance assessments are conducted and validated, and pollution prevention and other improvements are monitored for meeting EMS targets and objectives. In Phase Four, corrective actions are completed, improvements are instituted, and lessons learned are evaluated and integrated into the EMS framework. This system ensures that NSTec is aware of its impact on the environment, evaluates all work to ensure regulatory compliance, and executes work to conform to plans.

Each project or work activity is evaluated at or near conception for coverage under an existing National Environmental Policy Act (NEPA) document and for applicable legal and other requirements. This reveals, at a high level, the areas of potential impact. Further along in the planning process, when the work scope is refined, permits are applied for and controls are established to maintain compliance. If work is subcontracted, Environmental Programs (EP) reviews the proposal and adds terms and conditions, as necessary. EP also reviews all purchase requisitions for chemicals, ensuring compliance with existing permits and a disposal path for wastes. Disposal options for chemicals and containers are evaluated on a case-by-case basis to determine if the waste is simply solid waste and can be sent to an onsite landfill or if it is hazardous waste that must be properly managed and disposed of. Waste, either hazardous or solid, cannot be treated on site in any manner without approval from EP.

EP also conducts field inspections of work activities, especially activities at permitted and regulated facilities, to ensure compliance. EP conducts periodic programmatic assessments that may result in findings. Deficiencies from both of these programs are entered into caWeb and tracked to resolution.

Work packages that govern activity-level work are reviewed to ensure environmental aspects are noted and mitigations are prescribed. Work planners are provided checklists and other tools to determine when input from EP is needed. For recurring, routine work packages, the environmental aspects are already identified and hold points built in.

As Found Condition

Waste Management

While NPTEC has requested development of waste management plans and assistance in disposal of chemicals and debris resulting from tests, there are significant sectors of this work that are conducted outside of EP oversight. CD-P410.010, "Waste Management," provides guidance on waste management but does not require a waste management plan for each specific test. The development of previous waste management plans was initiated by personnel who are no longer associated with NSTec. NPTEC has a long-standing policy that customers either have to remove remaining chemicals or pay for disposal, but this policy is often subverted. Customers planning to return in the near future do not want to dispose of chemical supplies, and they ask NPTEC to store these chemicals, or the chemicals are also left in display boxes for future flyovers. To avoid accumulations of chemicals at NPTEC, additional waste management guidance needs to be provided. See Section 4.0 for additional information concerning waste management conclusions and judgment of needs.

NEPA Checklist

NPTEC incorporates environmental reviews in many phases of its programs, including review of test plans and review of purchase requisitions for chemicals. Instead of preparing a NEPA checklist for each specific test within a series, an overarching NEPA checklist has been prepared for a test series without details as to the type and quantity of chemicals that will be used and the disposal path for any remaining chemicals associated with specific tests. This document also lists activities, such as weekly inspections of chemical storage areas, that will be accomplished, and evidence of the accomplishment of the activities was not provided. CD-P410.002, "National Environmental Policy Act," provides a list of requirements for a NEPA checklist to be prepared, which includes initiation of a new project or when there is a change in project scope that might result in additional or different impacts. NPTEC has maintained that the current test is not a new project and therefore falls under the existing, overarching checklist. Opportunities for environmental reviews associated with tests and test series are limited at best.

Leaving Drum Uncovered

NPTEC personnel left the lid off of a drum of IPA to allow the remainder of the liquid in the container to evaporate, which constitutes a form of waste treatment per 40 CFR 260, "Hazardous Waste Management System: General." 40 CFR 260.10 defines treatment as "any method, technique, or process…so as to render such waste reduced in volume." Treatment of waste in this manner, however, is allowed only at a permitted Treatment, Storage, or Disposal (TSD) facility. NSTec has Resource Conservation and Recovery Act (RCRA) permits for storage of hazardous or mixed waste, disposal of hazardous or mixed waste, and treatment of explosive wastes, but does not have a permit for treatment of hazardous waste. While RCRA provides for certain treatment exemptions, evaporation is not a treatment method that has an exemption. CD-P410.010 provides guidance on waste management but does not provide specifics on what treatment of wastes means and what is prohibited.

OP-B725.001 requires that empty hazardous material drums be placed in lined steel pans and sealed to prevent moisture accumulation. This procedure does not provide for what constitutes an empty drum, although an interview with the Project Manager indicated that workers are aware that a drum is empty according to RCRA regulations when there is an inch or less of product remaining. This knowledge was gained during an Environmental Compliance Assessment in the 1999–2000 timeframe. The interview also indicated that leaving the lid off of the drum to facilitate "emptying" by evaporation is not a common work practice. The procedure does not discuss what should be done with remaining amounts of

chemicals to avoid similar "treatment without a permit" violations. The Project Manager also indicated that once drums have been determined to be empty, Solid Waste Operations is contacted to dispose of the empty drums. Solid Waste Operations indicated that there has been no work performed at NPTEC specific to removing empty containers.

CON 32 **The NPTEC NEPA documents have not been updated on a routine basis as different projects and use of different chemicals occur.**

CON 33 **Evaporation of chemicals in an effort to reduce the volume is considered treatment of a waste under RCRA and can only be performed by a permitted TSD facility.**

CON 34 **Procedures lack specificity regarding definition of an empty drum as well as how non-empty drums should be handled.**

JON 24 **NPTEC needs to ensure that procedures include appropriate handling instructions for drums, as well as clearly defining what constitutes an empty drum.**

JON 25 **NSTec needs to ensure that a NEPA document is prepared for each specific test conducted at NPTEC versus use of an overarching NEPA document.**

JON 26 **NSTec needs to ensure that company documents clearly indicate what is considered treatment under RCRA to avoid treating wastes without a permit.**

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8.0 FEDERAL OVERSIGHT

Ideal State

The NNSA/NFO process for conducting line oversight of contractors (including users), is defined in NFO O 226.X, "Line Oversight (LO) Program." The directive serves as the primary implementing mechanism for the following:

- U.S. Department of Energy Order DOE O 226.1, "Implementation of Department of Energy Oversight Policy"
- NNSA Supplemental Directive NA-1 SD 226.1, "NNSA Line Oversight and Contractor Assurance System Supplemental Directive"
- NNSA/NFO Policy NFO P 226.X, "NNSA/NFO Line Oversight System Description Document"

The objective of NFO O 226.X is to ensure that NNSA/NFO line oversight programs are comprehensive and well integrated.

Primary federal oversight at NPTEC consists of Operational Awareness Activities (OAAs), where routine day-to-day oversight is performed and documented by NNSA/NFO staff and management in the execution of their assigned responsibilities. OAAs are considered a form of "informal assessment," and typically include review of reports, attendance at meetings, inspection of field conditions, observation of work, evaluation of contractor performance data, and other activities conducted to maintain awareness of ongoing activities.

Operational awareness, used in conjunction with data derived from Contractor Assurance System processes and formal federal assessments, serves as the foundation for NNSA/NFO management and staff to make informed decisions regarding the health, success, and effectiveness of contractor activities.

Transactional-Based Oversight describes activities that assess contractor performance through evaluating activities at the work, task, or facility level. Transactional reviews provide direct, independent federal oversight of activities, physical conditions, and contractor documentation. This detailed level of oversight is utilized on high-risk activities, including NPTEC operations, or activities exhibiting problematic trends.

Formal assessments are approved by the NNSA/NFO Executive Council and scheduled on the NNSA/NFO assessment schedule. The schedule is based on the Assessment Implementation Plan, an NNSA/NFO document prepared annually to plan federal assessments, based on a semi-quantitative risk model and narrative text for each mission and functional area. This is submitted to NNSA/HQ as the Site Integrated Assessment Plan for NNSA BOP-10.003, and includes the NNSA/NFO Assessment Schedule.

As Found Conditions

Interviews conducted by the Board with NNSA/NFO Line Management identified that Conduct of Operations assessments are frequently performed across the NNSS. From 2011 a Conduct of Operations Management Assessment was conducted, including NPTEC as one of the facilities assessed. Beginning in 2013, various Conduct of Operations assessments were conducted focusing on specific elements of conduct of operations, which included On Shift Training, Lockout/Tagout, Communications, Control Area Activities, Logkeeping, and Technical Procedures. In 2014, NNSA/NFO has completed one assessment on Control of Equipment and System Status, with two assessments in

progress on Component Labeling and Operator Aids. Of the assessments identified above, the only two that were not applicable to NPTEC were Logkeeping and Operator Aids, since they are not applicable elements in the approved NPTEC Conduct of Operations Matrix.

The Assistant Manager for Site Operations (AMSO) administers the NNSA/NFO Facility Representative (FR) Program for all nuclear and high-hazard non-nuclear facilities. The NPTEC FR is responsible for monitoring performance of facility operations from an ES&H perspective and providing day-to-day transactional oversight of contractor operations to ensure that NNSA/NFO management has accurate information on contractor performance, with an emphasis on safety.

An interview with the NPTEC FR identified that the Facility Representative is on site for the POD meetings and during operational activities. The Facility Representative provided various operational awareness activities ranging from January 2014 to April 2014, documenting his oversight activities. One OAA in particular, OAA-14-AMSO-TPD-02/05/14, documented that a formal workplace inspection was conducted by NPTEC personnel on storage transportainers, tool sheds, and storage trailers. It was noted in the write-up of this OAA that drum labeling was documented as an item to be followed up on. Review of additional OAAs did not document any further discussion on drum labeling. The FR also stated that weekly reports are submitted for work activities conducted during the week. The FR was aware of issues with component labeling as documented above in the Operational Awareness Activity, but no NNSA/NFO issue was ever entered into caWeb identifying this concern.

Interviews conducted with NPTEC staff by the Board identified that the NNSA/NFO FR does attend the POD meetings and observes operational activities during vehicle drive-bys. A review of the FR designation letter documents that the NPTEC FR is assigned to the following facilities and work activities across the NNSS: NPTEC, Source Physics Experiments, Hazardous Material Transportation/ Utilities/Construction Projects/Work for Others/Office for Secure Transportation/Environmental Restoration.

With all of the activities assigned to this one individual, transactional oversight cannot be effectively performed at the appropriate level of rigor to ensure ISM is being maintained.

The Assistant Manager for National Security (AMNS) oversees and administers NPTEC operations using an assigned Mission Area Representative (MAR). MARs are responsible for monitoring performance of one or more missions and projects supported by multiple NNSA/NFO functions.

An interview of the NPTEC NNSA/NFO Project Manager (PM) identified that his role as project manager is to ensure that the project is properly funded and the mission is executed on schedule. His oversight activities include being present during mission activities and ensuring funding is available for overtime hours worked by NSTec employees. The PM was aware of concerns with long-term storage of chemicals and that NSTec has not included disposal costs of chemicals to clients. The reasoning was to ensure estimates were at the costs future clients are willing to spend. The PM does not document any operational awareness activities, which is consistent with NFO O 111.X, “Functions, Responsibilities, and Authorities,” but provides weekly reports on cost, scope, and schedule of NPTEC operations. The PM also mentioned that he interacts with the Facility Representative when in the facility.

The NNSA/NFO PM provides quarterly updates on project and mission status to the NNSA/NFO Manager and federal staff.

The Assistant Manager for Safety and Security (AMSS) performs safety oversight functions, including contractor Occupational Safety and Health programs and ISM implementation. AMSS Functional Area

Representatives (FARs) are assigned to oversee all aspects of worker protection, ensuring that their assigned functions satisfy defined requirements and are performed in a manner that adequately controls associated risks.

The NNSA/NFO IH FAR maintains good working relationships with contractor counterparts, based on trust and open communication. However, a significant portion of NPTEC oversight relies heavily on verbal discussion and contractor feedback with an understanding that, most of the time, the contractor is doing a good job. Field oversight was conditional and based on significant events or meetings, not routine observation of work in progress. Due to conflicting priorities and oversight of multiple facilities, the FAR did not spend any field time at NPTEC during the past seven months. Several years have gone by since the FAR walked down NPTEC, which is designated as a Moderate Hazard Facility.

Documentation reviews were sporadic and not current. An MSDS spot check was last performed over four years ago. In general, corporate and NPTEC directives were viewed as comprehensive and compliant with regulatory drivers. However, implementation of the directives was perceived by the IH FAR as less than adequate due to inattention or lack of strict procedural adherence.

An interview with the IH FAR also noted that, although the underlying hazards of the legacy chemicals were not well understood, it was recognized by operations staff and facility management that the chemicals should have been removed. Disposition discussions were occasionally held without any subsequent action. In the opinion of the IH FAR, it is still unclear who is responsible for managing the chemical inventory.

CON 35 **Current NNSA/NFO collateral duties do not ensure adequate field time at Moderate Hazard Facilities.**

CON 36 **Current NNSA/NFO oversight approach does not define performance-based attributes that enable effective transactional oversight.**

CON 37 **NNSA/NFO was not aware of the risk associated with legacy chemical storage at NPTEC.**

CON 38 **NNSA/NFO oversight placed a high reliance on the Contractor Assurance System, rather than direct observations of contractor performance.**

JON 27 **NNSA/NFO needs to develop and implement an effective performance-based oversight plan for all moderate-hazard activities.**

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9.0 ISSUES MANAGEMENT

Ideal State

CCD-QA03.001, "Issues Management," establishes the NSTec Issues Management Program and provides a consistent approach for issues management, as well as development, documentation, maintenance, and monitoring of a comprehensive, structured Quality Improvement Program for continual improvement. This CCD includes the identification, evaluation, investigation, analysis, data entry, tracking, corrective actions, and post-closure activities for identified noncompliances and opportunities for improvement (OFIs). As discussed in the CCD and detailed in its Appendix B ("Issue Closure Requirements"), issues management is a risk-based approach to addressing issues, i.e., the more significant the finding, the more rigor in determining the causes and substantial the actions as detailed in the corrective action plan (CAP).

An "issue" is a generic term that includes Findings (noncompliance with an established requirement) and OFIs (signs of less than optimal performance). Per the CCD, there are four priority levels for findings (PL-1 through PL-4), with PL-1 findings being the most significant and OFIs the least significant type of issue that is identified. Findings and OFIs may both be referred to as issues and may be derived from the following:

- Lack of compliance with requirements, such as federal laws, DOE and NNSA directives, contract requirements, procedures, or management expectation and/or policy, which requires formal corrective action or response
- Failure to "flow-down" a requirement through implementing procedures, or failure to perform a required action or execute a required responsibility
- Reportable Office of Enforcement and Oversight noncompliance (includes Price-Anderson Amendments Act, Worker Safety and Health and/or Security violations)
- Radiological or toxic material exposure limits being exceeded or radioactive or toxic material being lost or released
- Events, conditions, or situations that could adversely impact operations, personnel, or equipment
- Line management investigations
- Independent assessments (Internal or External)
- Identified conditions and deficiency reports
- Management assessments and/or surveillances
- Occurrence Reporting and Processing System (ORPS)
- Breach of Security Requirements or Incidents of Security Concern
- Deficiencies identified during workplace activities (formal workplace inspections, walkthroughs)

Issues may be identified internally or externally. Internally identified issues, or self-identified issues, may originate from NSTec activities identified above. Externally identified issues assigned to NSTec may originate from (but are not limited to) assessments by the company's Parent Organization Oversight Committee (POOC), Lloyd's Register Quality Assurance (LRQA), and ISO, in addition to state audits and/or inspections (e.g., State of Nevada, Nevada Division of Environmental Protection). Federally identified issues assigned to NSTec may originate from DOE HQ (e.g., Office of the Chief of Defense Nuclear Safety; Office of Health, Safety, and Security) or from NNSA/NFO.

Upon identification, the Issue Originator (IO) forwards the issue to the Responsible Manager (RM) who evaluates the issue to determine if they are willing to accept and address it. If agreement cannot be reached on the validity of the issue, it is placed into Conflict Resolution for elevation and disposition by the IO's and RM's management chain. If the RM agrees to accept the issue, then they establish the issue priority (PL-1 through PL-4 or OFI) by using the guidance provided in CCD-QA03.001. By establishing the priority level, they have determined the level of effort required for processing the issue through caWeb; the more significant the issue, the greater the rigor that must be applied to determine the causes and appropriate corrective actions. Upon acceptance, the RM forwards the issue entry template to the Issues Management Coordinator (IMC), who enters the issues into caWeb, and a unique identifier number is assigned. The Issues Management process allows issues to be placed on hold or canceled with justification, if certain procedural requirements are accommodated.

Subsequent to entry into caWeb, the issues are reviewed by the Issue Screening Team (IST). The purpose of the IST is to ensure issues are clearly described and meet basic reporting requirements. This review includes, but is not limited to, (1) consideration of the issue statement and description clarity, (2) identification of the stated requirements that were not met, and (3) the appropriateness of the issue priority level that was determined by the RM. The IST provides their comments, suggestions, and recommendations to the RM for consideration. The RM retains final authority and determination as to whether they will accept the IST recommendations. Although the IST process has been in place since 2012, the actual sequence of steps has changed. Until the January 1, 2014, issuance of Revision 6 of CCD-QA03.001, the IST review was done prior to issue entry into caWeb. For Priority Level 1 or 2 Findings that are event-based (e.g., pipe break, injury, environmental spill), the issue process begins by conducting a management review, also known as fact findings, critiques, or timelines. For non-events (e.g., PISA or lack of procedural compliance), the management review is optional. Management reviews are typically performed as part of the root cause analysis (RCA). An RCA is a rigorous evaluation of a problem to identify the basic cause(s) (i.e., root cause) that initiated the problem documented in the finding. Intrinsic to this evaluation is the performance of an Extent of Condition (EoC) analysis to determine the company-wide extent and generic implications of the problem.

Using the results of the RCA and EoC, a CAP is developed that will address the finding and/or minimize the probability and severity of any recurrence. Corrective actions must address the cause(s) and correct the finding. Each identified cause should be addressed by one or more actions. Justification should be provided for any causes not addressed by an action. One action may address more than one cause.

For Priority Level 3 Findings, the RM conducts an apparent cause analysis (ACA), which is a less rigorous and detailed evaluation than an RCA performed for PL-1 and PL-2 findings. The CAP uses the causes determined during the ACA to identify corrective actions that when implemented should minimize probability and severity of any recurrence. Intrinsic to this evaluation is the performance of an EoC to determine the potential extent of the problem for the RM's area of responsibility. Upon completion of the ACA, a CAP is developed to address the causes of the issue.

Priority Level 4 Findings do not require a formal cause analysis or the development of a CAP. However, the finding should be addressed with documented actions that the RM believes will minimize recurrence. A Priority Level 4 finding may be closed without taking action, but justification must be provided. If the finding is a noncompliance with any law, Code of Federal Regulation, requirement, or DOE order under the purview of the Office of Enforcement and Oversight, an action must be taken.

An OFI, while not addressing a violation of an established requirement, is a recommendation that indicates an area where, based upon the IO's opinion, performance may be improved and is worthy of being raised to the attention of management for possible action. The RM determines whether a CAP is

required or what, if any, actions will be taken. If no actions will be taken, the RM must submit an e-mail with justification when requesting closure of the issue.

When all actions are completed for a given issue, the RM reviews the objective evidence for the closure of each action and then forwards a request for closure of the issue to caWeb. For Priority Level 1 and 2 Findings, post-closure activities include corrective action verification (CAV) to independently verify acceptable completion of corrective actions, and corrective action effectiveness validation (CAEV) to independently evaluate the implementation of corrective actions. CAEVs are done on the PL-1 and PL-2 Findings that meet certain ORPS-defined categories (e.g., Operational Emergencies). Additional CAEVs may be performed at the discretion of the Quality Assurance Division Manager. Priority Level 3 activities are given a less rigorous CAV type review by the IST. Due to their low level of significance, PL-4 Findings and OFIs do not require any formal review after the issue is closed within caWeb.

As Found Conditions

The Board reviewed NPTEC and Port Gaston caWeb issues for calendar years 2009–present and identified multiple work control and chemical management (storage, use, labeling, compatibility, etc.) issues. A total of 192 issues were identified during this period, with distribution of issue type as follows:

Issue Type	Quantity	% of Total Issues
PL-2	2	1.04%
PL-3	43	22.40%
PL-4	97	50.52%
OFI	43	22.40%
Noteworthy Practice	1	0.52%
On Hold	4	2.08%
Cancelled with Justification	1	0.52%
No Priority Level Identified	1	0.52%

The above issues were identified through the Advanced SQL Query Syntax. The query identified 195 issues in total, of which 192 pertain to NPTEC.

NPTEC assigns about 73% of their issues as PL-4 or OFIs as compared with the company-wide average of 88% for Fiscal Year (FY) 2013 and FY 2014. This would indicate that NPTEC was actually placing a larger percentage of their issues into priority levels that would mandate a more rigorous review. While not an issue with respect to percentages, there are questions about how appropriately NPTEC assigned the priority of their issues. This and other concerns raised by the Board are discussed below.

1. <u>Priority Determination</u>

An assessment was done by NSTec Facility Programs and Real Estate Services from August 30 through October 10, 2012. This assessment was designated a “site assistance” assessment and documented as “Report on the Independent Assessment of NPTEC and Port Gaston Facility Management Program.” The site assistance assessment team determined that there were significant programmatic weaknesses in the flow-down of requirements and implementation of approved processes. This included weaknesses in the REOP and the FEP. The assessment also found that the approved processes, as implemented, were ineffective in fully achieving the desired end-state, and that the significant weaknesses reflected a challenge to the ISMS. CCD-QA03.001 states that the RM determines the priority level of all issues identified by NSTec. This determination is made through the use of the Priority Level Determination table or the Probability/Consequence Matrix tables. The Priority

Level Determination table identifies criteria for each priority level and OFIs. One of the criteria for a Priority Level 2 determination is a "Programmatic condition that represents a weakness in administrative or management controls or their implementation, to such a degree that broad management, process control, or project management problems exist." As the assessment report identified significant programmatic weaknesses, it is unclear why the NOD RM chose a Priority Level 4 for all of the findings rather than designating some of the issues as Priority Level 2 or 3 findings. (Note: Concerns about the assessment designation [i.e., type of assessment] and processing are addressed in Section 12.0 of this report.)

Examples of the Board's concerns regarding determination of appropriate priority level are as follows:

Issue 22810

Issue 22810 states the following in the detailed issue discussion:

> *The safety envelope in the NPTEC FEP-0033 does not mention "work for others" which is a primary mission for NPTEC.*

Issue 22811

Issue 22811 states the following in the detailed issue discussion:

> *Concerns with the NPTEC Primary REOP NSTec-0033 and Secondary REOP AC-001 Scope of Work/Safety Envelope:*
>
> - *Primary REOP does not reference waste generation (tenant answered yes in SEP-B725-00, HA, 1.g).*
> - *Primary REOP does not reference plant, animal and reptile monitoring/sampling (see Secondary REOP USGS-0003).*
> - *The NEPA for Primary REOP NSTec-0033 does not reference radiological waste (tenant answered yes in SEP-B725-00, HA, questions 3.a and 3.b), biological stimulants (see SEP-B725-00 HA 6.i.10), or aviation activities (see SEP-B725-00 HA 3.a & 3.b).*
> - *The scope of work in Secondary REOP AC-0001 does not mention lasers. However, lasers are listed as a hazard in Subpart C.*

These issues (28110 and 22811) were both entered by the RM as Priority Level 4. However, the Board's review of this issue determined that the most appropriate priority level would have been a PL-2 associated with a programmatic failure (i.e., FEP and REOP failed to address a primary mission of the NPTEC facility within the Scope of Work/Safety Envelope). As the assessment report identified significant programmatic weaknesses, it is unclear to this Board why a Priority Level 4 was chosen over a Priority Level 2.

With regard to the concerns raised in the Operations and Infrastructure assessment discussed above, the Board noted similar concerns pertaining to authorization basis–equivalent documents still in effect at NPTEC. These are more fully discussed in Section 3.0.

Issue 22753

Issue 22753 states the following in the detailed issue discussion:

> *FM not Tracking, Trending, and Addressing Issues.*
>
> *Instances of this condition were identified during the evaluation of CRAD 6.b.2.*
>
> - *Issues from previous assessments have not been adequately addressed in a timely manner. At least three management assessment reports, a surveillance report, and several dozen caWeb entries were analyzed during this assessment to determine trending issues. Many of the findings found during this assessment are repeat findings from previous assessments.*

This issue was entered into caWeb as a Priority Level 4. Upon transition of the facility to a NOD FM, the issue was closed based on a series of meetings held by the NOD FM to discuss and begin implementation of tracking, trending, and addressing issues. However, the Board's review of this issue determined that the most appropriate priority level would have been a PL-3 associated with the multiple occurrence and repeat nature of the issue.

Issue 22754

Issue 22754 states the following in the detailed issue discussion:

> *Compressed Gas Cylinders Not Properly Stored. Instances of this condition were identified during the evaluation of CRAD 8.j.*
>
> - *Several dozen compressed gas cylinders, in several locations across the complex are not stored with a roof to protect cylinders and markings from sun.*

This issue was entered into caWeb as a Priority Level 4. However, the Board's review of this issue determined that the most appropriate priority level would have been a PL-3 associated with the multiple occurrence and repeat nature of the issue over several locations across NPTEC. In addition, the storage of the cylinders in this manner is inconsistent with the applicable laws and recommendations.

2. Appropriate Processing of Issues

The second concern associated with the issues identified from the NSTec Facility Programs and Real Estate Services site assistance assessment involves the processing of issues into caWeb. This assessment identified 15 issues, but only 10 were entered into caWeb.

At the time that the issues were identified, the issue entry process was sequenced as follows:

- The IO forwarded the draft issue entry template to the RM. A copy of the template was forwarded to the IMC.
- The RM had seven calendar days to determine the priority level and forward the issue to the IST for review. If the issue was not processed within this time period, the RM and his management (including Directors) were made aware of the status of the issues via a routinely distributed email (typically weekly).
- The RM would forward the issue entry template to the IST for their review and comment back to the RM as appropriate.
- The IST would then forward the issue to the IMC for processing and entry into caWeb.

The IST has documentation indicating that the five missing issues were processed from the IO to the NOD RM. However, there is no indication that the issues were processed forward from the RM to the IST. It is unclear to this Board why these other five issues were not processed into caWeb. A JON is provided below to reconsider the status of these five issues.

3. Delaying the Addressing of Issues

In April 2012, Management Assessment MA-12-B700-002, "Nonproliferation Test and Evaluation Complex (NPTEC) Work Control," was completed. This assessment had three stated purposes: (1) ensure that NPTEC management and work planning personnel are correctly implementing company work control procedures as identified in the overarching CCD-QA05.001, (2) ensure personnel have a thorough understanding of the work control process, and (3) ensure that work is being performed in accordance with company procedures.

Seven findings and two OFIs were identified and assigned to a GS employee as the RM. The report states that "most of the findings related to this assessment are easily corrected, ranging from training deficiencies to using the correct form for work control documents." One of the most serious findings (Issue 21091) was the use of Type III work packages for subcontractors and employees not in the NPTEC Skill of the Worker Program. Other findings addressed workers and supervisors performing/ supporting activity-level work without completion of required Integrated Work Control Process training courses 1G000574 (Issue 21087) and 1G000574 (Issue 21088), respectively. Another issue addressed indication that the REOP holder or the Facility Manager had not authorized the activity-level work on Form FRM-2163, "Activity Level Work Document Coversheet." This form is typically used across the site but is not utilized at NPTEC.

All seven issues were prioritized as PL-4 and entered along with the two OFIs into caWeb on April 20, 2012. Five of the findings and both of the OFIs were closed on January 2, 2013, citing that no action was taken because "all work packages are closed." Issue 21089 was closed without any action "due to change in ownership of the facility (to NOD . . . from NPTEC)." Issue 21088 associated with training of the supervisors to the work control process was completed, but not until March 2013, which is almost a year after the finding was entered into caWeb. The current issues management process allows RMs to close PL-4 issues, under some circumstances, without taking any action and with stated justification. However, for these issues the justification was not based upon any solid rationale, but rather on simply delaying taking action until it became too late (i.e., the work packages have closed). In the case of the above-mentioned PL-4 issues, most were related to work control, and in particular work packages. By avoiding addressing the issues, NPTEC management missed an opportunity to correct minor problems that as a minimum may have encouraged the workers to have a questioning attitude. Instead, the lack of action enhanced the perception that there is no reason to raise concerns because they are not addressed. (Note: Further discussion on training issues is provided in Section 13.0 of this report.)

By not addressing the issues in a timely manner, the facility may have missed an opportunity to properly justify closure of eight of the nine issues without taking any action. The facility management accepted risk for something that was easy to address and could have acted as an opportunity to avoid future problems.

4. Placing Issue "On Hold"

The issues management process has a priority category of "On Hold." This priority was intended to be used when funding constraints, resource limitations, or project delays made the date for issue completion indeterminate. It was deemed to be an appropriate way to keep track of issues that otherwise would have due dates that were either indeterminate (i.e., the issue will not be addressed

until some project or customer is willing to pay for the effort) or many years out into the future. By procedure, the RMs can place the issue On Hold at their discretion; no additional approval/review is needed to justify transferring the issues to this status. A list of the issues that are On Hold is provided via email on a routine basis (typically weekly) to the RM and the Directors. On a quarterly or semi-annual basis, the status of these issues was a talking point at a monthly Executive Leadership Council meeting. Approximately a year ago, the Executive Leadership Council meetings were canceled, and none of the current standing Senior Management meetings have an expectation to discuss or status these On Hold issues.

A review of the issues that are currently On Hold confirmed that, of the 30 issues with this priority, four (18840, 20212, 22178, and 23958) have specific bearing on NPTEC and Port Gaston. All of the issues were placed On Hold because of lack of funding. They are discussed briefly below:

- Issue 18840 was entered into caWeb on December 9, 2010, with an expectation of an annual Fire Safety Assessment. The caWeb file indicates that no funding was provided for Engineering to support this effort.
- Issue 20212 was entered into caWeb on September 21, 2011, and addressed storage, labeling, the need for a chemical management plan, and waste disposal. At the time, the estimate to remove all of the chemicals from NPTEC was estimated to be approximately $11,000.
- Issue 22178 was entered into caWeb on August 28, 2012, and discussed incompatible storage of chemicals. The incompatible chemicals were segregated, but the larger need to develop a chemical management program was not.
- Issue 23958 was entered into caWeb on September 25, 2013, to document overdue periodic reviews of emergency procedures, emergency equipment, etc.

Although the issues were placed On Hold for plausible reasons, it is not clear to this Board if these designations were justified.

It is the opinion of this Board that issues have been placed On Hold by the RM to expedite other work activities. By placing the issue in this category, the issue is excluded from the need to take immediate action. The intent is to address the issue when time and resources become available. The workers see this as another example that identified issues are not being addressed, and they become frustrated with the process. This leads to acceptance of less than adequate conditions and procedures because workers feel unable to drive change.

Based on the results of this investigation, it appears that the RMs do not look beyond the funding cost when placing issues On Hold or consider risks associated with regulatory exposure. It also appears that non-conservative decisions in the field are based solely on time and resource constraints. Without any review or routine discussion of the status of these issues with Senior Management, an opportunity is lost for them to appreciate the risk that they are assuming. As an example, two of the four issues were placed On Hold because funding could not be provided for Engineering support. In summary, the RMs should have been more aggressive in pursuing funding to eliminate all of the legacy chemicals at NPTEC.

Historical Perspective

In 2003 between July 24 and July 28, there was an over-pressurization of a carbon steel tank containing hydrochloric acid at NPTEC (then referred to as the Hazardous Material Spill Center, or HMSC). The wind direction was not within the required window for testing; therefore, the test was postponed. The acid remained in the tank in direct sunlight. The weather conditions continued for the

next three work days, resulting in an ongoing delay in the test. By the end of the week, testing was still delayed. The material was left in the test vessel over the weekend. The relief valve degraded and failed to open, acid corrosion at localized weak points thinned the weld, and the tank subsequently suffered a longitudinal split. Upon returning to work on the following Monday, the results of the event were identified.

The event was documented as ORPS DP-NVOO--BN-NTS-2003-0011, "Ruptured Cylinder – Near Miss," and tracked to closure within caWeb as a PL-2 issue (Issue 02275). A root cause analysis was completed and 11 corrective actions identified. Five of these actions were administrative in nature and related to the issues management process (e.g., develop a CAP), but the other seven involved field actions intended to correct the causes and to minimize the potential for recurrence. Five of the six involved procedure/process changes, and the sixth action was to hire a dedicated FTE employee to fill the Engineering role previously performed by the HMSC Chemical Engineer and Systems Engineer.

A review of the caWeb issue file concluded the following:

- Only two of the corrective actions, both currently identified in the checklist derived from OP-NPTC.002, "Nonproliferation Test and Evaluation Complex (NPTEC) Hazard and Operability Study (HAZOP)," for considering environmental conditions, are still in place.
- The objective evidence provided in the file would indicate that all of the actions were appropriately addressed.
- Over time, all of the procedures that were revised went through revisions and were superseded.
- Two corrective actions associated with independent reviews of recovery plans and customer test documents were canceled with remarks indicating that the document no longer meets the needs of NPTEC and instead they will use NSTec project planning principles as guidelines for preparing for long- and short-term projects.
- One corrective action associated with chemical compatibility was eliminated with the most recent revision to OP-NPTC.002.
- One corrective action was for the hiring of an Engineer to fill the Engineering role previously performed by the HMSC Chemical Engineer and Systems Engineer. This position was filled, but when that person retired, the position was not re-filled.

CON 39 **NPTEC management of issues pertaining to activity-level work processes and chemical management have not been effective in reducing repeat findings.**

CON 40 **Due to time and resource constraints, RMs on occasion make non-conservative decisions when addressing issues. The result is that the corrective actions address the immediate problem without consideration of the systemic or programmatic causes.**

CON 41 **Due to the authority given to the RMs with regards to issues management, Senior Management is missing an opportunity to fully appreciate the non-conservative decisions that personnel are making based upon time and resource constraints and the risk NSTec may inadvertently be assuming.**

JON 28 **NSTec needs to ensure that NPTEC-related issues are evaluated in their totality to identify and address programmatic weaknesses, which may require issues to be re-opened, priorities adjusted, and/or additional action(s) taken.**

JON 29 **NSTec Management needs to ensure that the five issues from the Facility Programs and Real Estate Services site assistance assessment (conducted August 30 to October 10, 2012) are placed into caWeb and dispositioned.**

JON 30 **NSTec Senior Management needs to examine the disposition authority currently afforded to the RMs when dealing with issues.**

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10.0 MANAGEMENT

Ideal State

NSTec management concepts are captured in PD-M000.001, "Management Description." As described in this document, NSTec's support of NNSA/NFO and its customers is accomplished through the management and operation of government facilities and infrastructure at the NNSS, associated facilities in Nevada, and other locations in the United States as well as a diverse base of technical and service capabilities and resources. Through its management system, NSTec ensures that roles and responsibilities are clearly communicated, hazards and risks are identified and mitigated to an acceptable level, work is planned, requirements to achieve the desired results are identified, work to be accomplished is understood, and work is executed to plan.

Primary objectives established for NSTec by these directives include the following: establish the NNSS as the preferred location in the United States for conducting high-hazard experiments, implement an enterprise approach to project management with demonstrated excellence across core mission programs, and be a world-class example in the effective execution of work while asserting a safety, security, and quality culture transparent in all activities.

NSTec is committed to integrating safety in its work planning and execution processes and recognizes that line management responsibility, accountability, good management systems, and worker involvement are essential elements to success. NSTec managers are responsible and accountable for ensuring that work performed is executed according to the NSTec Integrated Safety Management System (ISMS). The fundamental structure of ISMS continues to rely on an integrated approach providing ISM controls at the site, facility, and activity level. For facilities with an authorization basis, the ISMS relies on the clear identification of each facility's authorization basis so that proposed work can be evaluated to ensure that it falls within the safety envelope.

As Found Conditions

Based upon a series of interviews with NSTec and NNSA/NFO Senior Management, the level of funding may not be adequate for NPTEC activities. Numerous comments were provided to this Board that funding may have been reduced inappropriately and may be contributing to a series of challenges noted throughout this report. The Board also identified that a significant cleanup of NPTEC facilities, including dispositioning of some excess chemicals, was conducted during 2005.

Since the inception of the NSTec Contract, there has been significant challenge with respect to balancing an appropriate level of adherence to governing regulatory criteria and NSTec implementing directives with the needs/expectations of WFO customers. Based on interviews, this was first observed during contract transition when NPTEC was under the HS&DA Directorate. While there have been a series of organizational realignments (see Figure 1-2 under Section 1.5.1), NPTEC Senior Management has had limited success in attempting to appropriately balance infrastructure needs (e.g., facility repairs/upgrades) and customer expectations (e.g., encountering pushback from customers who do not want to pay for such infrastructure considerations).

A series of interviews also noted friction and/or lack of support for the most recent realignment whereby NPTEC resides under two directorates (see Figure 10-1 below), Global Security (GS) and the Nuclear Operations Directorate (NOD).

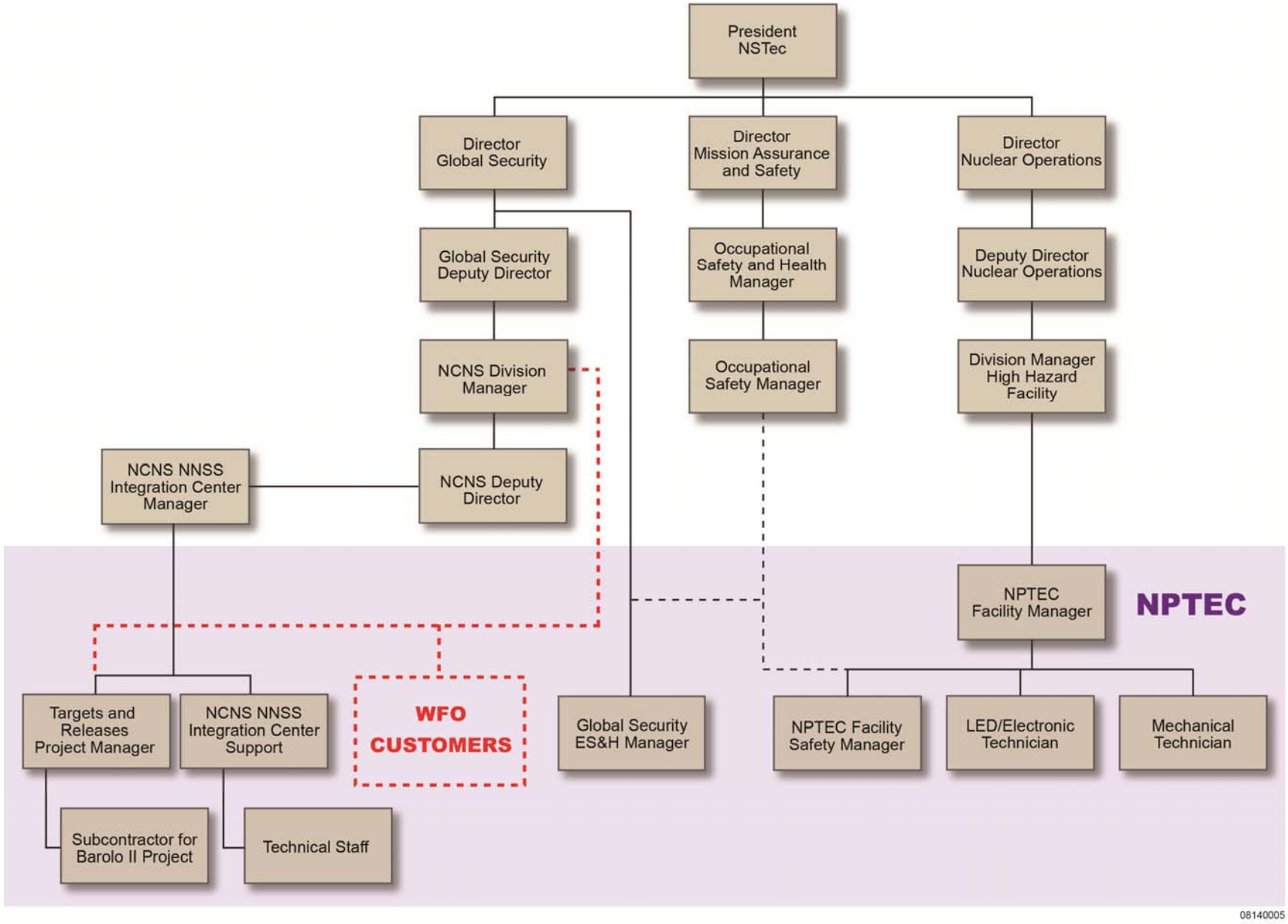

Figure 10-1. Current NPTEC Organizational Structure

GS is tasked with maintaining the customer base as well as developing additional capabilities, and NOD is responsible for facility management, including maintenance and staffing. Numerous interviews identified confusion among personnel regarding clear roles and responsibilities, as well as chain of command, and lack of clear vision regarding overall NPTEC objectives. This challenge is compounded by some NPTEC personnel having to support GS and NOD, contingent upon customer expectations.

During the transition process, NOD personnel identified a series of challenges regarding management of chemicals at NPTEC. However, budget requests submitted by NOD representatives to remediate excess chemicals were not acted upon by NSTec Senior Management. This Board noted similar challenges when chemical storage issues at NPTEC were previously identified by support organization representatives. While their concerns were appropriately entered into caWeb, in each instance, these issues were subsequently placed "On Hold" due to lack of funding.

Interviews with NNSA/NFO and NSTec Senior Management identified some instances of complacency (e.g., everything seems to working) due to a lack of understanding regarding potential risk associated with work being performed, as well as with storage of legacy chemicals. As noted in Section 12.0 of this report, the assessment processes implemented at NPTEC have not been effective, including in some instances not addressing all NPTEC facilities. In addition, no independent assessments have been conducted for NPTEC, which is designated as a Moderate Hazard Facility.

CON 42 **NPTEC facilities and processes are not being effectively managed. In addition, the potential hazards, and risks, associated with management of chemicals at NPTEC facilities are not readily understood throughout the NSTec management organization.**

JON 31 **NSTec needs to establish a comprehensive management strategy for NPTEC so that risks are identified, and appropriate abatement strategies are implemented. This strategy would also include a methodology whereby funding for essential facility infrastructure considerations are not dependent on individual customer preferences.**

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11.0 SAFETY CULTURE

Ideal State

DOE's policy related to safety culture is "An organization's values and behaviors modeled by its leaders and internalized by its members, which serves to make safe performance of work the overriding priority to protect workers, the public, and the environment." These tenets were reinforced in a September 20, 2013, Memorandum from Secretary Moniz, which also notes the importance of trust, mutual respect, questioning attitude, and fostering of a safety conscious work environment.

It is critically important that the visions, values, and beliefs established by the leadership to support a strong safety culture are clearly communicated and constantly reinforced. In many cases, management believes that their visions and values have been established and communicated through the development of a policy or procedure, or the posting of signs. That is an initial step and meets minimum compliance requirements, but it takes more than that. Leaders must constantly reinforce these expectations through observation and coaching at all levels of the organization.

In normal human activity, production behaviors naturally take precedence over prevention behaviors unless there is a strong safety culture – nurtured by strong leadership. Safety and prevention behaviors are value-driven, and people may not choose the conservative approach because of what is believed or perceived to be a stronger production focus.

Within DOE, most serious events do not occur when performing complex or high-hazard operations. They rarely occur when starting up new facilities or performing operations for the first time. That is because everyone is paying close attention, there are several people involved, things move slowly, and everyone is very "mindful." The natural tendency is to primarily focus on what are considered "high-hazard" or "high-risk" operations. The challenge for leadership is to establish and reinforce the safety culture expectations continuously so that workers are mindful and careful during all operations.

The ISMS Safety Culture Task Team organized by DOE and the Energy Facility Contractors' Group (EFCOG) identified three key ISMS Safety Culture Focus Areas: Leadership, Employee Involvement, and Organizational Learning. In turn, these key focus areas are supported by a series of attributes. Examples include clear expectations and accountability, management engagement and time in the field, risk-informed conservative decision making, trust, questioning attitude, and reporting of resolution.

As Found Conditions

This Board reviewed available information from a Nevada Enterprise (NvE) Employee Survey addressing safety culture, and from the NvE Safety/Security Culture Assessment (S/SCA) conducted in the summer of 2013. This S/SCA was led by NSTec and NNSA/NFO to assess the health of the safety/security culture across the NvE. The S/SCA Team obtained data through personnel interviews, evaluation of employee surveys, document reviews, and facility walk-downs. Overall, the S/SCA Team determined that while work was being accomplished in a safe and secure manner, stressors to the collective culture were identified that could preclude the NvE from achieving organizational excellence.

The S/SCA effort consumed considerable resources, with over 250 interviews being conducted. S/SCA membership comprised numerous NvE organizations, including NNSA/NFO and NSTec, as well as a Safety Culture SME and representatives from DOE and NNSA/HQ. The final S/SCA Report was subsequently issued on August 28, 2013.

As mentioned above, the S/SCA Report identified stressors in the overall safety/security culture that could preclude the NvE from achieving organizational excellence. The following key topics of concern were identified in the report: open communication; fostering an environment free from retribution; credibility, trust, and reporting of errors/problems; and effective resolution of reported problems. A series of additional topics were identified that also needed to be addressed by the NvE: risk-informed, conservative decision making; management engagement and time in the field; staff recruitment, selection, retention, and development; clear expectations and accountability; teamwork and mutual respect; participation in work planning and improvement; performance monitoring; use of operational experience; and a questioning attitude. A series of these topics were also identified as needing improvement in a 2010 NvE Culture Survey utilizing similar criteria.

Despite the significant level of effort expended to conduct the S/SCA, and the series of topics rated Red (expectations not met), there have been limited communications regarding actions taken to enhance the NvE safety/security culture that are clearly linked to the 2013 S/SCA results. While an NvE Culture Assessment Action Team (CAAT) was established in October 2013, members from the S/SCA with significant experience in safety/security culture concepts, as well as insight gained from participating in the S/SCA effort, were not selected for CAAT membership. The CAAT developed a list of corrective actions for consideration by NvE Senior Leadership, which allowed each organization the flexibility to determine what corrective actions to implement. The CAAT was then dissolved in March 2014.

Over the last few months, the NNSA/NFO Manager has instituted a series of efforts addressing results of the S/SCA Report. Examples include one-day retreats, and allowing federal personnel to step away from routine assignments to participate in one- to two-week efforts of process improvement teams. Interviews and informal discussions with federal personnel noted an awareness of these activities, with mixed results. In some instances, federal personnel thought the efforts were making a positive difference. Others felt they were more of a “touchy-feely” exercise and they wanted to continue with current practices.

While both NNSA/NFO and NSTec management personnel have continued to participate in the We-Lead Training, there were very few other examples identified regarding NSTec addressing results of the S/SCA Report. This is due, in part, to direction provided by NNSA/HQ to NNSA/NFO regarding “holding off” on definitive actions until NNSA/HQ personnel reviewed collective results. Based on a series of interviews during this investigation, the Board has determined that this lack of visibility to effectively address results of the S/SCA Report has resulted in many individuals feeling disenfranchised regarding their participation in the S/SCA effort.

Leadership

As discussed in numerous publications addressing safety culture, leadership involvement is essential to any endeavor. This was an area identified as not meeting expectations in the NvE S/SCA Report. As noted in Section 1.5.1 of this report, there have been a series of organizational changes at NPTEC. Results of interviews identified that the latest organizational change, whereby NOD would be responsible to facility operations, was to instill a “nuclear operations” attitude for day-to-day activities. While this is being viewed as a value by both GS and NOD Senior Management, there is very limited presence at NPTEC by these same individuals.

GS Senior Management has visited NPTEC when accompanying clients/customers, but has not routinely met with NPTEC facility personnel outside of these visits. Due to a series of prior process challenges identified with nuclear safety, NOD Senior Management has had to place their focus on nuclear facilities and, as such, has not visited NPTEC nor routinely met with NPTEC facility personnel. While both directorates have noted some improvement at NPTEC since transition of facility operations

to NOD, it was also acknowledged that additional effort is needed. However, the lack of Senior Management can present a significant challenge when personnel are expected to change undesirable behaviors that have been instilled for many years. This Board also noted the inability of GS/NOD to work as an integrated team to ensure long-term sustainability of the NPTEC mission.

While an FM and an AFM have been assigned for NPTEC, these same individuals also serve in these roles for other NSTec facilities at NNSS. On the day of the accident, neither the FM nor AFM were present at NPTEC. Interviews with NPTEC personnel and support organization representatives noted a lack of clarity regarding roles, responsibilities, and authorities. In addition, the NPTEC LED identified himself as serving in an Authorized Facility Manager function. However, subsequent discussions with the FM revealed that the NPTEC LED has not been authorized to serve in such a capacity.

Interviews also noted that the NNSA/NFO MAR for NPTEC has very limited, if any, communications with the NNSA/NFO NPTEC FR. The NNSA/NFO MAR has not recently visited the NPTEC facility and periodically reviews NPTEC FR Weekly Reports (versus discussing facility performance with the NPTEC FR). However, these weekly reports commonly capture only high-level information, versus more detailed insight that would be conveyed during iterative discussions.

Employee/Worker Engagement

As noted above, a series of challenges were identified in the NvE S/SCA Report that address employee/worker involvement. Of particular note were culture assessment results addressing hesitancy to raise issues, fear of reprisal, and lack of accountability.

During this investigation, the Board identified similar challenges regarding personnel not consistently identifying facility issues, being hesitant to bring up concerns, or simply not attempting to utilize existing processes to capture these concerns. Reasons provided included facility maintenance requests not being acted upon; management appearing to place a higher priority on mission versus facility infrastructure needs; and prior issues not being resolved. Interviews also identified challenges regarding clear roles and responsibilities, including points of contact for concerns or issues. As noted in Section 10.0, a series of caWeb entries addressing challenges with chemical inventory/management practices were put “On Hold.” Interviewees noted this as a key example of personnel not elevating their concerns to the next tier of management. Supporting discussions identified a perception of management as not being engaged, “why bother” bringing the issue up again, and similar feelings of frustration.

Low morale was also noted by some personnel. Contributors to this condition were uncertainty of funding and job security, inability to clean up/remove old chemicals, and complaints by customers that NPTEC is “too expensive.” All of these challenges are further compounded by lack of Senior Management presence at the facility and the FM/AFM having to serve in this capacity for multiple facilities.

Organizational Learning

The S/SCA Report also identified challenges regarding performance of management assessments. This Board identified numerous instances where assessments addressing NPTEC were not comprehensive in nature or results were not acted upon. In one instance, the former director of NOD directed that a facility assessment conducted by the Facilities Oversight Organization not be identified as an Independent Assessment or entered into the Joint Assessment Schedule. This resulted in the assessment report not being assigned a unique identification number, which, in turn, rendered it exceptionally difficult to track in the NSTec Issues Management System. The Board also identified that

while routine facility inspections have been conducted in accordance with CD-P280.006, "Formal Workplace Inspection Program (FWIP)," these inspections did not address the East and West Motel locations. In other instances, management assessments consisted of driving by the Motels to conduct a visual observation, versus a "boots on the ground" walk-down to gain additional insight regarding chemical storage practices and facility conditions.

Based on a review of available information, there have been no Independent Assessments of the NPTEC Program conducted by the NSTec Quality Assurance and Control Division. In addition, other than routine NNSA/NFO Facility Representative Reports, no NNSA/NFO oversight assessments have been conducted.

It appears there has been a historical overreliance by NSTec on ISO 9001 and ISO 14001 Assessments conducted by LRQA and/or those performed by the Nevada Division of Environmental Protection. However, these types of assessments are commonly fairly narrow in scope and do not result in the broad-based perspective afforded by comprehensive independent assessments conducted by personnel with the requisite experience and expertise. In addition, the previous HS&DA Director prohibited NPTEC from participating in the ISO 9001/14001 process.

From a cultural perspective, this Board identified a series of challenges associated with lack of effective line management, including ineffective communications with personnel responsible for performance of work at NPTEC and lack of consistent oversight in the field. Since inception of the NSTec Contract, the work environment at NPTEC has devolved into an atmosphere of indifference and/or lack of situational awareness. This contributed to personnel performing work (e.g., chemical transfers) without hazards and controls being identified, and ongoing storage of legacy chemicals in violation of governing regulatory and NSTec directive criteria.

This culture of indifference and lack of situational awareness continued to be demonstrated after the accident. By way of example, the NPTEC LED advised F&R personnel that the area was "safe to enter" immediately after the accident, even though there were chemical odors and liquid present. During a staff meeting held the week of June 23 to review the accident, NPTEC personnel concluded that the accident was a "freak occurrence" and could not have been prevented. During interviews, the Board also noted comments from NSTec personnel regarding this accident being viewed as "just an SME issue," versus recognizing a series of challenges at the system/program level.

CON 43 **NNSA/NFO and NSTec have not effectively communicated efforts to address results of the 2013 S/SCA Report.**

CON 44 **The transition of NPTEC facility operations to NOD has yet to achieve the anticipated benefits. The lack of Senior Management visibility and consistent facility management presence is counter to maintaining an effective safety culture (e.g., no consistent line management visibility).**

CON 45 **The NNSA/NFO MAR and FR do not maintain effective internal communications regarding status of NPTEC facilities and associated operations.**

CON 46 **In some instances, NPTEC personnel are no longer utilizing caWeb, MAXIMO, and similar processes to identify concerns, issues, or facility repairs.**

CON 47 **Routine evaluations of NPTEC facilities and processes are not being consistently performed in accordance with established criteria.**

CON 48 **Comprehensive Independent Assessments of NPTEC activities have not been conducted by NSTec (i.e., Quality Assurance Program and Parent Organization Oversight Committee).**

JON 32 **NNSA/NFO and NSTec need to examine options to reengage personnel whereby results of the S/SCA Report are examined, process improvements clearly linked, and successes publicized/celebrated.**

JON 33 **NSTec needs to enhance efforts to convey desired behaviors to NPTEC personnel as well as ensuring GS and NOD Senior Management increase their visibility at NPTEC.**

JON 34 **NSTec needs to ensure that Moderate Hazard Facilities have an FM who can maintain focus on safe and compliant operations.**

JON 35 **NNSA/NFO needs to examine current methods being utilized to monitor NPTEC operations, including enhancing communications between federal project and oversight personnel.**

JON 36 **NSTec needs to reinforce the use of caWeb, MAXIMO, and similar processes to identify issues, concerns, and facility maintenance needs.**

JON 37 **NSTec needs to ensure that all NPTEC facilities, and processes, are routinely evaluated in accordance with established criteria, including the use of SMEs as appropriate for these evaluations.**

JON 38 **NSTec needs to ensure Independent Assessments of NPTEC facilities and processes are conducted.**

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12.0 SELF-ASSESSMENT AND CORPORATE OVERSIGHT

12.1 Self-Assessment

Ideal State

The NSTec self-assessment program comprises Independent Assessments (IAs), Management Assessments (MAs), Surveillances, and Fire Safety Assessments (FSAs). Additional assessments that might be included on the Joint Assessment Schedule (JAS) (at the discretion of the RM) include external assessments, readiness assessments, internal audits, and configuration management assessments. These assessments are managed using the JAS. The JAS is a dynamic database intended to establish a single assessment schedule that is available to all NSTec and NNSA/NFO personnel, to promote full Line Oversight/Contractor Assurance System transparency while improving coordination and use of site assessment resources.

NSTec determines the topics for assessments using three initiating processes. First are assessments required by the NSTec Contract. Second, the NSTec Annual Analysis Report (AAR) provides the results of NSTec's annual analysis of its assurance processes for the 3 key mission and 24 functional areas identified by NNSA/NFO. For each of these areas, the appropriate Manager does a detailed evaluation of the performance of their organization over the past 12 months. As part of this effort, they review their caWeb issues. Using their performance and issue evaluations, they determine MAs that they will be performing in the upcoming fiscal year and recommend IAs for consideration and performance by the Quality Assurance and Control Division. The third initiating process is an annual "call" put out to Managers within each Directorate requesting their identification of topics to be assessed. With the exception of assessments required by the NSTec Contract, the extent and frequency of assessments are determined by the RM and are based on a graded approach that reflects the importance of the activity, the potential for error in the work process, the consequences of failure, the inherent risks involved, and management priorities.

The identified MAs and the IAs accepted by the Quality Assurance and Control Division are added to the JAS for the upcoming fiscal year. By design, the JAS is a dynamic schedule, as such assessments may be added, canceled, etc., based upon emergent activities and changing priorities. Initial populating of the JAS for the upcoming fiscal year is completed in August of the preceding year.

In an effort to improve coordination among assessment resources, NSTec and NNSA/NFO have developed an integrated approach through use of the JAS to schedule assessments. The assessment schedule developed by NSTec for the next fiscal year is submitted to NNSA/NFO on or before August 15. Upon receipt, NNSA/NFO develops their Assessment Implementation Plan, which takes into consideration the NSTec assessment schedule. Once finalized, the NNSA/NFO assessments are added to the JAS. By using an integrated schedule, the number of redundant assessments is minimized while maintaining transparency by providing access to the assessment plans and reports completed by each organization.

As Found Conditions

<u>Assessment Determination</u>

Review of the NSTec AARs for FY 2010 through FY 2014 established that NOD and GS and their predecessor organizations did not request IAs for NPTEC, nor did any organization request an IA of the chemical management program or processes. These AARs included a review of assessments, issues, and emerging concerns to determine the assessments to be scheduled for the following fiscal year.

Throughout this period, the health of NPTEC operations from a directorate-level perspective has been rated as Green in the AARs (meaning that performance is acceptable or exceeds expectations with only minor weaknesses noted).

Management Assessments and Surveillances

There is no set frequency or number of MAs and surveillances that are established by the assessment programs. The RM is tasked with determining the frequency of the scheduled assessment. The Board reviewed the JAS from 2005 forward (refer to Table 12-1 below) and found that overall the number of self-assessments performed at the facility was appropriate. In fact, the number of assessments has increased over the past several years as people do more surveillances, and NOD activities have added NPTEC to routine MAs that cover multiple facilities.

Table 12-1. NPTEC Assessments

FY	Assessments Scheduled	Assessments Completed	Comments
2005	2	2	–
2006	2	1	One MA replaced by SME assistance visit
2007	1	1	–
2008	2	2	–
2009	1*	1	*Independent assessment
2010	3	3	–
2011	5	5	Plus one surveillance and three NNSA/NFO reviews
2012	12	9	Plus 5 surveillances
2013	10	6	Plus 2 surveillances

The Board reviewed MA reports for appropriate depth, breadth, and scope from the period of October 1, 2008, through July 1, 2014. Again, the determination of the rigor and detail of the MAs is solely at the discretion of the RM so that they can focus on the areas that are the most critical to their needs. Most of the self-assessments being conducted are by the facility and program. In FY 2013 and FY 2014, the IH Department performed an oversight self-assessment of hazardous chemical use and storage.

Overall, the MAs and surveillances were conducted to an appropriate level of rigor. There has been a common theme associated with self-assessment findings pertaining to chemical management and work control at NPTEC Area 5 and Port Gaston locations. The conclusions reached and the issues identified (i.e., labeling and chemical inventory) in the assessment reports merit attention. It is the opinion of this Board that the challenge relates to how the issues are addressed and the subsequent actions taken, rather than what was identified in the assessment reports. This topic, including lowering prioritization and ineffective corrective actions, is discussed further in Section 9.0.

Independent Assessments

The Board identified IAs that included some level of evaluation of NPTEC facilities and/or operations in the following areas: emergency management, procurement, fire protection, integrated work control, facility management, conduct of operations, and control of nonconforming items. However, most of these assessments involved a scope that was addressed across multiple facilities and not specifically at the performance of NPTEC. As an example, IA-14-P510-005, “Independent Assessment of the Control of Nonconforming (NCR) Items,” included NPTEC as one of multiple facilities that were evaluated for appropriate implementation of the Nonconformance Report process. The assessment

identified two issues (24473 and 24489) directly related to NPTEC, but the review was of limited scope and did not evaluate overall operational performance.

The only IA that was focused solely on NPTEC was IA-09-EP10-004, "Independent Assessment of Nonproliferation Test and Evaluation Complex (NPTEC) Facility Level Implementation of the Emergency Management Program." This FY 2009 IA's purpose was to confirm that the Facility Level Emergency Management Program had been incorporated into procedures and implemented. Although this assessment reviewed only NPTEC, the scope was extremely limited. During this same period of time, multiple MAs and surveillances were conducted in the general areas of chemical management, to include items such as chemical and/or explosives inventory, control, labeling, use, storage, training, work control, and conduct of operations.

Upon NPTEC facility transition in FY 2012 from HS&DA to NOD, the NPTEC NOD Facility Manager, during a walk-down of the facility, identified several concerns with the facility chemical management program. At the request of NOD management, a site assistance assessment was conducted by NSTec Facility Programs and Real Estate Services from August 30 to October 10, 2012. The resulting report was titled "Report on the Independent Assessment of NPTEC and Port Gaston Facility Management Program." Although using the IA report format and acknowledging the use of IA requirements, it was not reported as an IA or entered into the JAS.

This report identified 11 findings and 4 OFIs, and noted that previous assessments had found similar issues. It also stated that there were significant programmatic weaknesses in the flow-down of requirements and in the implementation of approved processes. The assessment also determined that the approved processes, as implemented, were ineffective in fully achieving the desired end-state, and that the significant weaknesses reflected a challenge to the ISMS. The Executive Summary of that assessment concluded:

> *It is the considered judgment of the Assessment Team that:*
>
> - *Identified Findings in the flow down of the requirements have resulted in significant programmatic weaknesses*
> - *Identified Findings in the implementation of the approved processes have resulted in significant programmatic weaknesses*
> - *The approved processes, as implemented, are ineffective in fully achieving the desired end-state*
> - *The Findings identified in the assessment demonstrate significant programmatic and/or systemic conditions and reflect significant challenges to the Integrated Safety Management System.*

It is unclear to this Board why the decision was made to not process the report into the JAS, but one of the undesired results was that not all of the identified issues have been processed into caWeb. This resulted in a possible missed opportunity to address and resolve challenges associated with legacy chemicals, although this Board noted that prior issues addressing this topic had been put on hold due to perceived lack of funding. Refer to Section 9.0 for additional discussion.

Fire Safety Assessments

FSAs are required by DOE O 420.1C, "Facility Safety." FSAs evaluate elements such as life safety, fire protection of vital programs, fire suppression equipment, facility fire protection planning documents, and potential for toxic, biological, and/or radiological incident due to a fire. FSAs are required to be

conducted annually for facilities, including NPTEC. This Board determined that the most recent NPTEC FSA was completed in 2009. Moreover, the 2009 NPTEC FSA was not conducted by a qualified fire protection engineer.

12.2 Corporate Oversight

Ideal State

The Parent Organization Oversight Committee (POOC) is a group of recognized experts from NSTec's parent organizations who provide advice and recommendations to the NSTec Board of Directors on key issues affecting the performance of NSTec. The function of the POOC is to provide an independent assessment capability to the NSTec Board of Directors – beyond the self-assessments performed by NSTec personnel – to increase the level of quality performance in NSTec activities. The POOC was tasked with the identification of discrepancies and recommendation of corrective action to the NSTec Board of Directors and senior NSTec staff.

The POOC is not a full-time body. Rather, individuals are tasked by the NSTec Board of Directors on an as-required basis. Approximately 15 individuals serve on the POOC at various times depending on the area of emphasis. Each is a recognized authority in his or her field, is familiar with activities at NNSS, and is committed to a rigorous review process intended to evaluate and improve NSTec performance. Most POOC members are drawn from the parent organizations, but others with special skills may be obtained from outside sources as required.

Annually, the POOC develops and submits to NNSA/NFO a Parent Organization Oversight Plan to address topics of concern to the NSTec Board of Directors and President, with emphasis on the following:

- Environment, Safety, Health, and Quality
- Safeguards and Security
- Nuclear Operations
- Engineering, Design, and Construction

Execution of the Oversight Plan results in documented reports to the NSTec Board of Directors and President. Deficiencies and recommendations are entered into NSTec's issues management system, and the status of corrective actions is briefed to the NSTec Board of Directors on a recurring basis.

As Found Conditions

Based upon document reviews and examination of issues management system data, the POOC has not, since contract initiation in July 2006, performed any reviews of NPTEC operations in general or of chemical safety in particular. Although multiple reviews touched on various aspects of worker safety and health, integrated safety management, and work control, none captured deficient conditions associated with NPTEC operations or chemical safety.

CON 49 **POOC has not conducted independent assessments of NPTEC operations or chemical safety in general.**

CON 50 **The Quality Assurance and Control Division has not conducted routine Independent Assessments evaluating Moderate Hazard Facilities, including NPTEC.**

CON 51 **GS and NOD have not effectively evaluated their project and facility as a whole to evaluate potential programmatic weaknesses, including those across the directorates, at both the project and facility levels.**

CON 52 **FSAs for NPTEC are not being conducted in accordance with prescribed schedules.**

JON 39 **NSTec needs to ensure FSAs are performed for NPTEC in accordance with prescribed schedules.**

JON 40 **NSTec needs to establish a process whereby POOC representatives, and/or outside SMEs, periodically evaluate performance of Moderate Hazard Facilities, including NPTEC.**

JON 41 **NSTec needs to establish a routine cycle for IAs of Moderate Hazard Facilities.**

JON 42 **NSTec needs to ensure GS and NOD periodically assess how effectively they perform their joint responsibilities for NPTEC.**

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13.0 TRAINING AND QUALIFICATION

Ideal State

The cornerstone of safe operation of DOE facilities is personnel performing the day-to-day functions that accomplish the facility mission. Training that is conducted efficiently and effectively and is directly related to the needs of the job (i.e., performance-based training) is fundamental to safe operation. Responsibility for the safe operation of these facilities is a line-management function. Therefore, achieving performance-based training requires commitment from the organization for which training is provided. This commitment includes making SMEs available for participation in and review of the products of the performance-based training process. It also includes budgeting and scheduling the time required for both initial and continuing training. This commitment should be made by Senior Management from the beginning. Management should get involved at the start to ensure that they are not only cognizant of ongoing activities but are also involved to the degree necessary to thoroughly understand the process. Policies implemented and support demonstrated by Senior Management provide the driving force to ensure that training programs receive the attention necessary for facility training programs to be successful.

The most effective training programs are systematically developed using a performance-based process (such as the Systematic Approach to Training). This process provides structure yet is flexible and can be applied with a graded approach, to produce varying levels of rigor as safety requirements and risk dictate. Training programs are developed and maintained by a central Training organization, and management is engaged at all levels to assign, monitor, and ensure training requirements are fulfilled by employees. Once training programs are implemented and completed, successful performance requires their integration into all phases of work.

Execution plans (facility, project, and/or support), implementing documents, and work packages identify training and qualification requirements in order to ensure that workers possess the knowledge, skills, and abilities necessary to perform their assigned work safely. More rigorous training and qualification requirements may be required for work involving higher hazard facilities or activities. Managers/ supervisors are responsible for identification and documentation of training requirements consistent with hazards and requirements identified in execution plans and applicable implementing documents. Only trained workers are allowed to perform work; line management is responsible for ensuring that workers have the required knowledge, skills, and abilities before being assigned to perform a task.

As Found Conditions

NPTEC has a primary and alternate Facility Manager (FM) who authorize work at the facility. These individuals are qualified under the NSTec Facility Manager program. FAC0150, “Facility Manager for Non-Nuclear Facilities Qualification Program Development Plan,” outlines position requirements. The Facility Manager for Non-Nuclear Facilities Job Analysis Report outlines the duties/tasks and training considerations. NPTEC also has three individuals designated as work approvers. All individuals are listed as work approvers on the Facilities Oversight Department Facility Manager Program website. To approve work, personnel must have completed 1G000574, “Integrated Work Control Process (IWCP),” for initial training and 1G00W574, “Integrated Work Control Process (WBT),” every two years.

Initial qualification and training requirements are identified by the NPTEC FM in accordance with CCD-QA02.001, “Training Program Manual,” and documented on the NSTec Training Requirements Questionnaire. The FM is also required to arrange for appropriate training or certification to remedy any deficiencies in the employee’s qualifications or for training and qualifications not provided in the Training Requirements Questionnaire. Employee training is refreshed at least every three years.

OP-NPTC.003, "Nonproliferation Test and Evaluation Complex (NPTEC) Qualification and Training," describes the qualification and training requirements for NSTec full-time permanent employees working at NPTEC. NPTEC conducts work under two work packages: 3001084189, "Facility Support and Operations Activities," and FY14-NNSS-X352, "Targets and Releases Barolo." Both work packages identify training requirements. Based on a review of documentation as well as interviews, a series of challenges were identified regarding currency of training:

- A number of NPTEC employees have training that is not current. Examples include Hazardous Waste Site General Worker, Waste Management for the Generator, Hazardous Material Driver's Training, First Aid, and cardiopulmonary resuscitation (CPR). In addition, some NPTEC personnel have training requirements identified on their Employee Qualifications Requirement Report for tasks they no longer perform.

The following training deficiencies were identified for the NPTEC subcontractor who was injured in the accident that occurred on June 13, 2014:

- Out of a total of 43 required training courses, 21 were not current (i.e., 49% not current), as identified on the Employee Qualifications Requirement Report dated June 17, 2014.
- In addition, the subcontractor had not been assigned the following training classes: Self-contained breathing apparatus (SCBA) training (required by work package FY14-NNSS-X352); 1A000325, "Conduct of Operations for Nuclear and High-Risk Facility Workers"; and 1E000565, "Pressure Safety Requalification."

CON 53 **Not all NPTEC personnel have ensured required training is being maintained.**

CON 54 **NSTec has not ensured that appropriate training has been assigned for NPTEC subcontractor personnel nor ensured that this training has been completed prior to performance of work.**

JON 43 **NSTec needs to ensure appropriate training has been identified, and successfully completed, for all personnel supporting NPTEC operations/activities prior to performance of work.**

14.0 WORK CONTROL

Ideal State

The NSTec Integrated Work Control Process (IWCP) provides a structured and systematic process for planning and controlling all activity-level work (ALW) to ensure that ALW is performed in a safe and compliant manner. ALW is controlled through the development, approval, authorization, and execution of technical procedures, work packages, or project-level documents. The concepts of ISM and Quality Assurance are seamlessly integrated into this process.

Hazard analysis of ALW performed by NSTec begins with a scope of work that defines the work to be accomplished, and the safety requirements that must be met for safe completion of the work. Results of the hazard analysis review and associated controls are documented in activity level work documents (ALWDs), work packages, and similar documents.

Work packages contain a scope of work and a hazard analysis as a minimum. The scope of work provides a descriptive statement of the purpose, type of activity, requirements, and hazards of the defined task. The Activity Hazard Identification Checklist (AHIC), required for every ALWD, is an overarching checklist used to identify hazardous activities associated with activity-level work. The AHIC identifies the need for mandatory SME involvement and the driving documents that affect the ALWD. A job hazard analysis (JHA) defines the basic sequential steps of a proposed activity, the risks associated in performing a step, and the step-specific mitigating controls. A PTHR is used to communicate hazards and controls of the work.

As Found Conditions

This Board determined that the IWCP has multiple mechanisms that trigger the Work Planning Team to ask questions in the development of the scope of work and identification of hazards and associated controls: the AHIC, JHAs for Type II Work Packages, the Skill of the Worker (SOTW) process, a facility walk-down, and finally use of the PTHR to identify hazards and controls.

The work package instructions for NPTEC activities associated with this accident addressed installation and maintenance of equipment being used to support testing and operations, but provided no instructions for opening drums or for transferring and dispensing chemicals. This is viewed by the Board as a significant gap, since transferring of chemicals requires grounding of containers and other specific handling precautions for flammables, as specified in the MSDS and CD-P280.029.

The work package instructions, however, do include minimum requirements for PPE: specifically, safety shoes, safety glasses, and PPE identified during the PTHR review. Safety shoes were addressed in the work package, the AHIC, the JHA, the POD meeting, and the PTHR, but were not being worn at the time of the accident by the injured employee, who sustained lacerations to his right foot. The employee later disclosed that he was aware of the requirement in general, but it did not occur to him on the day of the accident.

The AHIC also identified the job task to include open chemical transfers or handling or shipping, but these were not analyzed in the JHA. The AHIC required that the MSDS be reviewed and instructed use of Appendix A of the ALWD. The Board was not able to ascertain how these task elements were overlooked during development, approval, and use of the work package.

The JHA for this activity included activities of handling hazardous and nonhazardous materials. The hazards identified for this activity included potential chemical exposure. Controls included safety shoes,

gloves, and safety glasses. The JHA also specified that each project have a specific hazard communication document (Appendix A of ALWD) that specifies chemical hazards and current PPE. The project-specific hazard communication document for this activity included the chemicals intended for use, hazards, and PPE. This is the first mention that IPA was going to be used as a chemical display on concrete pads, along with additional PPE specifying the need for natural rubber or butyl rubber gloves.

The Board was provided two NPTEC work packages for review: Facility Work Package #3001084189, Rev #1 (Type II Work Package), and Project Work Package # FY14-NNSS-X352-Barolo, Rev #1 (also a Type II Work Package). While several requests were made during this investigation regarding additional work packages that would be applicable to the ALW performed at NPTEC, no others were provided.

Although the Barolo project work package contains sufficient detail for a Type II Work Package addressing the various release mechanisms that will be utilized during the Barolo test series, it does not address work steps that are involved prior to and after the test releases, where handling of chemicals is being performed by NPTEC staff. The purpose of the work package includes “staging chemicals and equipment.” This work package does not address chemical handling, chemical transfers to the release vessels, and chemical movement and storage. The JHA for this work package has one job step that addresses “Handling hazmat and non-hazmat chemicals,” with the risk being a “potential chemical exposure” and the mitigation to “ensure correct PPE is being worn” when handling any chemical. The facility work package addresses traditional facility infrastructure activities, but does not address the handling of chemicals.

The project work package PTHR notes “working with a variety of chemicals,” with controls to include review of MSDS, environmental review, and proper disposal of materials. These items would commonly generate additional checks and balances, including SME concurrence. No evidence was provided that such activities occurred. Consequently, this contributed to the hazards of IPA not being fully recognized, storage requirements not being met, and the chemical exceeding its useful lifetime.

According to interviews, during transfer of the IPA from the 55-gallon drum on June 11, personnel observed that the coating on the inside of the drum was sloughing off. This abnormal condition was described as being equivalent to flaking of paint, “weird,” and was reported to supervision. Follow-up interviews by the Board revealed less than adequate communication between project personnel and the project supervisor regarding the condition of the drum interior. However, neither a Time Out nor a Stop Work was initiated, no photos were taken, nor was evidence presented of any precautions being put in place. An interview of the facility safety professional revealed that this concern was not communicated to him until after the incident.

In accordance with CCD-QA05.001, development and subsequent revision of work packages require performance of a walk-down in the field, or tabletop review, of proposed work activities. Contrary to this requirement, Revision 1 of the project work package was routed to a series of individuals for their review and sign off. This prevented affected parties from meeting as a team to ask questions about scope change. Revision 0 of the project work package did not address hazardous activities related to transfer and dispensing of chemicals. This gap was carried forward to Revision 1.

CON 55 **NPTEC activity-level work packages did not address transfer or dispensing of chemicals. This resulted in cascading failures with respect to IWCP elements designed to ensure proper analysis of hazards, development of controls, and performance of work within those controls.**

CON 56 **The process used to evaluate proposed revision of the project work package did not include a walk-down or an effective tabletop review whereby all affected parties could be afforded the opportunity to review revisions as a team.**

JON 44 **NSTec needs to ensure IWCP is effectively implemented for all NPTEC program and project activities.**

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15.0 ANALYSIS

15.1 Barrier Analysis

After a basic chronology of events was developed, the Board performed a barrier analysis of the accident. To start the barrier analysis, the Board chose a target (the person or item to be protected) and the hazard (what the person or item is to be protected from). The Board chose the NPTEC workers as the target and exposure to the explosion of the "event" drum as the hazard.

A total of twelve (12) barriers were identified and analyzed by the Board.

The barrier analysis is presented in Appendix B.

15.2 Change Analysis

To further support the development of causal factors, the Board performed a change analysis of the accident, examining the planned and unplanned changes that caused the undesired results or outcomes related to the event.

A total of seven (7) changes were identified and analyzed by the Board.

The change analysis is presented in Appendix C.

15.3 Event and Causal Factors Analysis

After performing the barrier and change analyses, the Board assigned the results of the various analyses to the conditions that were related to or caused the events in the chronology. Correlating these conditions with events resulted in the events and causal factors chart provided in Appendix D. When the correlation was complete, the Board examined the chart to determine which events were significant (i.e., which events played a role in causing the accident). The Board then assessed the significant events and the conditions of each, to determine the causal factors of the accident.

The causal factors that resulted are described below.

Direct, Root, and Contributing Causes

Direct Cause – the immediate events or conditions that caused the accident.

It is the opinion of this Board that the preponderance of evidence indicates that the direct cause of the event was the detonation of shock-sensitive peroxides caused by movement of the event drum.

Root Cause – casual factors, that if corrected, would prevent recurrence of the same or similar accidents.

The Board identified three root causes to the drum explosion event:

1. **The safety culture at NPTEC did not facilitate the effective identification and resolution of problems.** Personnel were reluctant to raise concerns, due in part to lack of effective resolution from previous attempts to address problems. Concerns with bulk storage of aging chemicals were assigned the lowest possible priority, or actions deferred, and challenges regarding bulk storage of legacy chemicals were not elevated to higher levels of management.

2. **NSTec failed to fully implement formality and operational rigor necessary for managing and operating NPTEC.** NPTEC operations were not adequately staffed or managed to ensure effective implementation and control of activities. Limited NOD management presence hindered the ability to achieve effective CONOPS implementation.

3. **NSTec did not effectively manage chemicals in a safe and compliant manner, including the disposition of legacy chemicals.** NSTec does not have a comprehensive company-wide Chemical Safety and Lifecycle Management Program, and NPTEC does not have a Chemical Hygiene Plan. The NPTEC West Motel was not authorized for storage of flammable/combustible substances, and chemicals of unknown origin, and/or unknown content, were stored at this location for several years.

Contributing Causes – events or conditions that collectively with other causes increased the likelihood or severity of an accident but that individually did not cause the accident.

The Board identified three contributing causes to the drum explosion event:

1. **The transition of NPTEC facility management from GS to NOD created a false sense of security with respect to the formality of facility operations.** NOD management did not provide ongoing feedback to achieve the anticipated increase in operational rigor. NSTec Senior Management was not aware of the adversarial relationship/unhealthy tension between GS and NOD that promoted a culture of indifference related to the storage of legacy chemicals.

2. **NPTEC Facility and Program organizations did not effectively manage issues.** On occasion, responsible managers made non-conservative decisions when addressing issues due to time or resource constraints, resulting in corrective actions that address the immediate problem without consideration of the systemic or programmatic causes.

3. **NSTec and NNSA/NFO processes did not enable risk-informed decision making regarding operation and maintenance of NPTEC.** NPTEC oversight (facility, project, federal) did not fully recognize hazards associated with storing bulk/legacy chemicals in the West Motel. NOD has not established minimum criteria for operation and maintenance of NOD Moderate Hazard Facilities such as NPTEC.

16.0 CONCLUSIONS AND JUDGMENTS OF NEED

Table 16-1. Conclusions and Judgments of Need

Conclusion (CON)	Judgment of Need (JON)
Authorization Basis	
CON 1: The West Motel was not appropriately analyzed or approved for chemical storage in the NPTEC REOP. **CON 2:** The periodic review, update, and approval of NPTEC facility documentation did not identify hazards associated with storage of chemicals at the West Motel. **CON 3:** NSTec has not required establishment of comprehensive "authorization basis" documentation, or equivalent, to ensure Moderate Hazard Facilities are operated in a safe and compliant manner.	**JON 1:** NSTec needs to ensure that the NPTEC REOP addresses all potential hazards and their locations, including storage of chemicals. **JON 2:** NSTec needs to perform an Extent of Condition review of REOPs for other Moderate Hazard facilities to ensure that all potential hazards are identified and appropriately mitigated. **JON 3:** NSTec needs to develop comprehensive "authorization basis" documentation, or equivalent, for Moderate Hazard Facilities.
Chemical Safety	
CON 4: NSTec has not developed a corporate-level program to ensure all aspects of chemical safety and lifecycle management are integrated and consistently addressed at the facility level. **CON 5:** NSTec does not have a Chemical Safety AHJ, or equivalent individual, responsible for enforcing chemical safety requirements. **CON 6:** There were no provisions to confirm at any periodicity that the most recent MSDS (incorporating current chemical hazard information) is available for use at NPTEC. **CON 7:** The NPTEC MSDS Index was not developed or maintained in accordance with the NSTec HAZCOM company directive. **CON 8:** The NPTEC hazardous materials management procedure did not institute adequate procurement controls to minimize chemical-related hazards. **CON 9:** NSTec has not implemented an automated chemical tracking system to provide real-time (dynamic) inventory management of chemicals in all facilities.	**JON 4:** NSTec needs to establish procurement controls that that enable just-in-time contracts and ensure only the minimum amounts of chemicals needed to perform planned work are ordered. **JON 5:** NSTec needs to consider implementing an effective hazardous waste management plan. **JON 6:** NSTec needs to consider implementing an automated tracking system that will enable real-time (dynamic) inventory management of chemicals in all facilities. **JON 7:** NSTec needs to consider establishment of a single "corporate approved" MSDS for all chemicals, including a mandatory review periodicity (e.g., annually). **JON 8:** NSTec needs to examine options to enhance performance of HHEs. **JON 9:** NSTec needs to consider implementing a comprehensive CSLM Program that ensures all aspects of chemical safety and management are integrated and consistently addressed at the facility level.

Table 16-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Chemical Safety (continued)	
CON 10: No evidence exists in the form of tests or inspections to demonstrate that the minimum functional capabilities of the NPTEC grounding systems were met to ensure safe operations. **CON 11:** The NPTEC West Motel is not an "approved flammable liquid storage room," as required by CD-P280.029. **CON 12:** Containers used for storing hazardous chemicals at NPTEC were not labeled as required (i.e., chemical identification and appropriate hazard warnings). **CON 13:** Incompatible chemicals were not stored separately as required to prevent contact in the event of an accident. **CON 14:** HHEs performed at NPTEC did not appropriately categorize the facility and did not identify improper storage of chemicals. **CON 15:** NPTEC has not implemented a documented process that identifies, in a timely manner, excess chemicals and appropriate protocols for reuse, recycle, or disposal. **CON 16:** NSTec has not developed a CHP for NPTEC.	**JON 10:** NSTec needs to consider development and implementation of CHPs for selected facilities, including NPTEC. **JON 11:** NPTEC needs to ensure chemicals are appropriately stored in accordance with governing NSTec requirements and MSDS criteria.
Conduct of Operations	
CON 17: The Board determined that while the NPTEC CONOPS program is well defined in the associated CONOPS Implementation Matrix, it has not been effectively implemented. **CON 18:** Staffing plans were not produced and technical support line management was unable to state what was considered "minimum staffing" for safe operations. **CON 19:** Configuration Management has not been formally assessed by NSTec for non-nuclear facilities. **CON 20:** Impact of out-of-service cameras was not recognized.	**JON 12:** NSTec needs to ensure that a comprehensive CONOPS program is effectively implemented for all NPTEC activities in a tailored manner versus attempting to implement a Formality of Operations process. **JON 13:** NSTec needs to ensure that facility equipment required to support project activities (e.g., cameras) is effectively maintained whereby it can perform its intended function. **JON 14:** NSTec needs to conduct an Extent of Condition review of other NSTec facilities implementing the DOE CONOPS program.

Table 16-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Conduct of Operations (continued)	
CON 21: Logkeeping and turnover of duties and responsibilities are not being conducted in accordance with company requirements. **CON 22:** Facility-level procedures do not accurately reflect currently approved company directives. **CON 23:** GS and NOD management promoted the concept of "Formality in the Workplace," in lieu of "Conduct of Operations," thereby diluting the importance of a long-standing overall philosophy for achieving excellence in the operation of DOE facilities.	
Emergency Management	
CON 24: NPTEC emergency planning documents do not clearly identify those hazardous materials that, while screened out from further analysis in the EPHA, may be considered initiators or promoters of a release of other toxic substances. **CON 25:** The LED and DM decision-making process for the event categorization/ classification process was not consistent with their respective processes and training. **CON 26:** The transfer of the 9-1-1 call from the Nye County Dispatcher to the OCC Fire Dispatcher was not consistent with the verbal agreement and expectations of the OCC Department Manager. **CON 27:** The notification to the onsite Nye County Sheriff's Deputy by the WSI-Nevada CAS was not consistent with the Nye County Sheriff's Mercury Sub-Station Lieutenant's expectation of timeliness. **CON 28:** The OCC Fire Dispatch Centracom link to the F&R Fire Station Public Address link did not operate as designed.	**JON 15:** NSTec needs to evaluate its current screening process for identification of those hazardous substances that, while screened out from analysis in an EPHA, may be considered initiators or promoters of a release of those toxic substances analyzed in the EPHA. **JON 16:** NSTec needs to evaluate its current process for documenting those hazardous substances that, while screened out from further analysis in the EPHA, may be considered initiators or promoters of a release of other toxic substances analyzed in the EPHA. **JON 17:** NSTec needs to evaluate its categorization/classification process and training to ensure that personnel with categorization/classification decision-making responsibilities are following their respective processes and training. **JON 18:** NSTec needs to evaluate establishing a more formal agreement with the Nye County Sheriff's Office to capture expectations for transferring NNSS-specific 9-1-1 call information.

Table 16-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Emergency Management (continued)	
CON 29: The LED's initial assessment of the scene was not completely accurate, nor did he recognize the potential hazards remaining at the scene. Information provided by the LED to the OCC Duty Manager, Fire Dispatcher, and responders downplayed the actual incident conditions. **CON 30 (POS):** F&R personnel continued scene assessment after arriving at the West Motel and, recognizing that there were still potential hazards, evacuated all personnel to a safe location. **CON 31:** Although an inventory of chemicals housed in the West Motel structure was available, it was from March 2014 and the LED gave the impression that he could not confirm current inventory status. This deteriorated trust between the IC and facility SMEs.	**JON 19:** Nye County Sheriff's and WSI-Nevada's leadership need to evaluate current documentation (if any) requiring timely notification to Sheriff's Deputies by the CAS. **JON 20:** NSTec Information Technology needs to evaluate the effectiveness of the Centracom to Public Address link in the OCC and Fire Stations 1 and 2. **JON 21:** NSTec needs to evaluate whether current LED training is adequate to properly perform incident size-up, event recognition, and relay of critical incident information in a factual manner to emergency services personnel. **JON 22:** F&R personnel need to be recognized for having a questioning attitude and evacuating all personnel out of the hazard area based upon remaining potential hazards. **JON 23:** NSTec needs to evaluate the current method of configuration management in regards to chemical inventory, storage, compatibility, and use at the NPTEC Facility.
Environmental Compliance	
CON 32: The NPTEC NEPA documents have not been updated on a routine basis as different projects and use of different chemicals occur. **CON 33:** Evaporation of chemicals in an effort to reduce the volume is considered treatment of a waste under RCRA and can only be performed by a permitted TSD facility. **CON 34:** Procedures lack specificity regarding definition of an empty drum as well as how non-empty drums should be handled.	**JON 24:** NPTEC needs to ensure that procedures include appropriate handling instructions for drums, as well as clearly defining what constitutes an empty drum. **JON 25:** NSTec needs to ensure that a NEPA document is prepared for each specific test conducted at NPTEC versus use of an overarching NEPA document. **JON 26:** NSTec needs to ensure that company documents clearly indicate what is considered treatment under RCRA to avoid treating wastes without a permit.

Table 16-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Federal Oversight	
CON 35: Current NNSA/NFO collateral duties do not ensure adequate field time at Moderate Hazard Facilities. **CON 36:** Current NNSA/NFO oversight approach does not define performance-based attributes that enable effective transactional oversight. **CON 37:** NNSA/NFO was not aware of the risk associated with legacy chemical storage at NPTEC. **CON 38:** NNSA/NFO oversight placed a high reliance on the Contractor Assurance System, rather than direct observations of contractor performance.	**JON 27:** NNSA/NFO needs to develop and implement an effective performance-based oversight plan for all moderate-hazard activities.
Issues Management	
CON 39: NPTEC management of issues pertaining to activity-level work processes and chemical management have not been effective in reducing repeat findings. **CON 40:** Due to time and resource constraints, RMs on occasion make non-conservative decisions when addressing issues. The result is that the corrective actions address the immediate problem without consideration of the systemic or programmatic causes. **CON 41:** Due to the authority given to the RMs with regards to issues management, Senior Management is missing an opportunity to fully appreciate the non-conservative decisions that personnel are making based upon time and resource constraints and the risk NSTec may inadvertently be assuming.	**JON 28:** NSTec needs to ensure that NPTEC-related issues are evaluated in their totality to identify and address programmatic weaknesses, which may require issues to be re-opened, priorities adjusted, and/or additional action(s) taken. **JON 29:** NSTec Management needs to ensure that the five issues from the Facility Programs and Real Estate Services site assistance assessment (conducted August 30 to October 10, 2012) are placed into caWeb and dispositioned. **JON 30:** NSTec Senior Management needs to examine the disposition authority currently afforded to the RMs when dealing with issues.

Table 16-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Management	
CON 42: NPTEC facilities and processes are not being effectively managed. In addition, the potential hazards, and risks, associated with management of chemicals at NPTEC facilities are not readily understood throughout the NSTec management organization.	**JON 31:** NSTec needs to establish a comprehensive management strategy for NPTEC so that risks are identified, and appropriate abatement strategies are implemented. This strategy would also include a methodology whereby funding for essential facility infrastructure considerations are not dependent on individual customer preferences.
Safety Culture	
CON 43: NNSA/NFO and NSTec have not effectively communicated efforts to address results of the 2013 S/SCA Report. **CON 44:** The transition of NPTEC facility operations to NOD has yet to achieve the anticipated benefits. The lack of Senior Management visibility and consistent facility management presence is counter to maintaining an effective safety culture (e.g., no consistent line management visibility). **CON 45:** The NNSA/NFO MAR and FR do not maintain effective internal communications regarding status of NPTEC facilities and associated operations. **CON 46:** In some instances, NPTEC personnel are no longer utilizing caWeb, MAXIMO, and similar processes to identify concerns, issues, or facility repairs. **CON 47:** Routine evaluations of NPTEC facilities and processes are not being consistently performed in accordance with established criteria. **CON 48:** Comprehensive Independent Assessments of NPTEC activities have not been conducted by NSTec (i.e., Quality Assurance Program and Parent Organization Oversight Committee [POOC]).	**JON 32:** NNSA/NFO and NSTec need to examine options to reengage personnel whereby results of the S/SCA Report are examined, process improvements clearly linked, and successes publicized/celebrated. **JON 33:** NSTec needs to enhance efforts to convey desired behaviors to NPTEC personnel as well as ensuring GS and NOD Senior Management increase their visibility at NPTEC. **JON 34:** NSTec needs to ensure that Moderate Hazard Facilities have an FM who can maintain focus on safe and compliant operations. **JON 35:** NNSA/NFO needs to examine current methods being utilized to monitor NPTEC operations, including enhancing communications between federal project and oversight personnel. **JON 36:** NSTec needs to reinforce the use of caWeb, MAXIMO, and similar processes to identify issues, concerns, and facility maintenance needs. **JON 37:** NSTec needs to ensure that all NPTEC facilities, and processes, are routinely evaluated in accordance with established criteria, including the use of SMEs as appropriate for these evaluations. **JON 38:** NSTec needs to ensure Independent Assessments of NPTEC facilities and processes are conducted.

Table 16-1. Conclusions and Judgments of Need (continued)

Conclusion (CON)	Judgment of Need (JON)
Self-Assessment and Corporate Oversight	
CON 49: POOC has not conducted independent assessments of NPTEC operations or chemical safety in general. **CON 50:** The Quality Assurance and Control Division has not conducted routine Independent Assessments evaluating Moderate Hazard Facilities, including NPTEC. **CON 51:** GS and NOD have not effectively evaluated their project and facility as a whole to evaluate potential programmatic weaknesses, including those across the directorates, at both the project and facility levels. **CON 52:** FSAs for NPTEC are not being conducted in accordance with prescribed schedules.	**JON 39:** NSTec needs to ensure FSAs are performed for NPTEC in accordance with prescribed schedules. **JON 40:** NSTec needs to establish a process whereby POOC representatives, and/or outside SMEs, periodically evaluate performance of Moderate Hazard Facilities, including NPTEC. **JON 41:** NSTec needs to establish a routine cycle for IAs of Moderate Hazard Facilities. **JON 42:** NSTec needs to ensure GS and NOD periodically assess how effectively they perform their joint responsibilities for NPTEC.
Training and Qualification	
CON 53: Not all NPTEC personnel have ensured required training is being maintained. **CON 54:** NSTec has not ensured that appropriate training has been assigned for NPTEC subcontractor personnel nor ensured that this training has been completed prior to performance of work.	**JON 43:** NSTec needs to ensure appropriate training has been identified, and successfully completed, for all personnel supporting NPTEC operations/activities prior to performance of work.
Work Control	
CON 55: NPTEC activity-level work packages did not address transfer or dispensing of chemicals. This resulted in cascading failures with respect to IWCP elements designed to ensure proper analysis of hazards, development of controls, and performance of work within those controls. **CON 56:** The process used to evaluate proposed revision of the project work package did not include a walk-down or an effective tabletop review whereby all affected parties could be afforded the opportunity to review revisions as a team.	**JON 44:** NSTec needs to ensure IWCP is effectively implemented for all NPTEC program and project activities.

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17.0 BOARD MEMBERS AND ADVISORS

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Division Manager, Occupational Safety & Health
National Security Technologies, LLC

Eric Amarescu
Senior Nuclear Safety Advisor
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APPENDIX A
Appointment Letter

National Security Technologies LLC
Vision • Service • Partnership

E000-RJ-14-0082

July 25, 2014

Steven J. Lawrence, Manager
Nevada Field Office
U.S. Department of Energy
National Nuclear Security Administration
P.O. Box 98518
Las Vegas, NV 89193-8518

Subject: **CONTRACT DE-AC52-06NA25946, FORMAL NOTIFICATION OF THE ESTABLISHMENT OF AN ACCIDENT INVESTIGATION BOARD**

This letter is formal notification that National Security Technologies, LLC (NSTec) and the National Nuclear Security Administration Nevada Field Office (NNSA/NFO) have established an Accident Investigation Board (Board) to investigate the drum explosion incident at the Nonproliferation Test and Evaluation Complex, Nevada National Security Site, on Friday, June 13, 2014.

NSTec has appointed Mike Kinney, Division Manager, Occupational Safety and Health, to co-chair the Board. Pursuant to your direction, Eric Amarescu, Senior Nuclear Safety Advisor, NNSA/NFO, will co-chair the Board with Mr. Kinney.

The Board will be assisted by advisors and consultants as well as other personnel as determined by the co-chairs.

The scope of the Board's investigation includes, but is not limited to, identifying all relevant facts; analyzing the facts to determine the direct, contributing, and root cause(s) of the drum ignition; developing conclusions; and determining judgments of need to prevent recurrence. The investigation is being conducted in a formal manner and to specifically address the role the NNSA/NFO and contractor management systems may have contributed.

A draft report will be provided by the Board to the senior leadership of the NNSA/NFO and NSTec for factual accuracy review prior to finalization.

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Steven J. Lawrence
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If you have any question regarding this letter, please contact Jim Holt, Vice President, at 702.295.4476.

Raymond J. Juzaitis, Ph.D.
President

JLH/tkr

cc: Correspondence Management
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APPENDIX B
Barrier Analysis

Table B-1. Barrier Analysis Listing

	Hazard: Explosion of 55-gal metal drum		**Target: Workers 1 and 2**		
ID #	**What were the barriers?**	**How did each barrier perform?**	**Why did the barrier fail?**	**How did the barrier affect the accident?**	**Context: ISM**
B1.	NSTec Chemical Management Program	Ineffective	NSTec has not developed a chemical management program. NPTEC has not developed a chemical hygiene plan. Existing NPTEC documents do not clearly address chemical storage and disposal. MSDS is not current.	Facility/Project did not manage the lifecycle of chemicals (from cradle to grave) with chemical safety in the context of ISM to ensure that all aspects of chemical safety and management were coordinated together and adequately addressed. Chemical safety (e.g., safe use and storage of chemicals) is only one part of chemical lifecycle management, but even this piece was not managed correctly. West Motel was not an approved chemical storage area. Inventory control, chemical identification, labeling, storage, compatibility, environmental conditions were less than adequate for storage of chemicals. MSDS did not identify storage limitations or special hazards; Chemwatch MSDS was used (a generic MSDS) instead of manufacturer's MSDS.	**CF 3; GP 5**
B2.	Conduct of Operations Program	Ineffective	CONOPS not internalized with NOD and GS personnel at NPTEC facilities. Facility level procedures are not consistently implemented.	Lack of rigor and complacency	**CF 1, CF 4; GP 1, GP 7**

Table B-1. Barrier Analysis Listing (continued)

	Hazard: Explosion of 55-gal metal drum		Target: Workers 1 and 2		
ID #	**What were the barriers?**	**How did each barrier perform?**	**Why did the barrier fail?**	**How did the barrier affect the accident?**	**Context: ISM**
B3.	Management of Issues	Ineffective	Deficiencies were not always entered into the issues management system for appropriate action or effective actions were not taken. Missed opportunity to identify programmatic concerns. Risk of not properly addressing issues not appreciated.	Effective corrective action would have resulted in removal of the legacy chemicals before peroxide formation could have resulted.	**CF 5; GP 1**
B4.	Hazard Identification and Control	Ineffective	Scope of Work, and associated work package, did not address handling and transfer of chemicals, resulting in cascading failures of hazard identification and controls. Workers were unaware of the storage limitations of IPA. Workers were unaware of potential for peroxide formation. Workers failed to review MSDS prior to storage of chemicals.	Hazards associated with the work and the respective controls were not identified; therefore, could not mitigate event.	**CF 2; GP 5, GP 6**
B5.	Oversight Program – NNSA/NFO	Ineffective	NNSA/NFO oversight did not consistently identify and document deficiencies in chemical management. When deficiencies were documented, NNSA/NFO oversight failed to monitor completion of effective corrective actions.	Detection and effective corrective action would have resulted in removal of the legacy chemicals before peroxide formation could have resulted.	**CF 5; GP 6**

Table B-1. Barrier Analysis Listing (continued)

	Hazard: Explosion of 55-gal metal drum		Target: Workers 1 and 2		
ID #	**What were the barriers?**	**How did each barrier perform?**	**Why did the barrier fail?**	**How did the barrier affect the accident?**	**Context: ISM**
B6.	Oversight Program – Contractor (Facility, Project, ES&H)	Ineffective	NSTec oversight did not consistently identify and document deficiencies in chemical management. When deficiencies were documented, NSTec oversight failed to monitor completion of effective corrective actions. Facility management did not ensure compliance with hazardous materials storage requirements or identification of special hazards. Project manager did not recognize hazards. IH health hazard evaluation did not identify noncompliant storage conditions.	Detection and effective corrective action would have resulted in removal of the legacy chemicals before peroxide formation could have resulted.	**CF 5; GP 1**
B7.	Personal Protective Equipment (PPE)	Ineffective	Worker #1 did not comply with PPE requirement to wear safety shoes.	Injuries were more severe.	**CF 4; GP 6**
B8.	Adequate Staffing	Ineffective	Employees, such as FM, supervisor, and ES&H personnel, provide only part-time support of facility and operations, as they have other assigned duties outside of NPTEC.	Ineffective oversight of maintenance, operations, and safety of NPTEC facilities, to include project activities	**CF 1; GP 4**

Table B-1. Barrier Analysis Listing (continued)

	Hazard: Explosion of 55-gal metal drum		Target: Workers 1 and 2		
ID #	**What were the barriers?**	**How did each barrier perform?**	**Why did the barrier fail?**	**How did the barrier affect the accident?**	**Context: ISM**
B9.	Procedures and Work Packages	Ineffective	Documents did not address all work activities, such as chemical handling and transfer. Workers did not comply with procedure that required placement of lid on drum. MSDS and manufacturer recommendations for storage (e.g., cool, well-ventilated area away from sunlight) were not followed as required by procedures. Skill of the Worker (SOTW) – not developed.	The chemical was stored under environmental conditions and for periods of time not recommended by manufacturer. Leaving lid off nearly empty drum allowed for evaporation and concentration of IPA, along with formation of peroxides. Reliance on SOTW process, which was not fully implemented, contributed to poor work package development.	**CF 4; GP 5**
B10.	Roles and responsibilities	Ineffective	GS/NOD roles and responsibilities for NPTEC not clearly defined or effectively implemented.	Ownership for disposition of legacy chemicals was not readily acknowledged by GS/NOD.	**CF 1; GP 2**
B11.	Stop Work/Time Out	Ineffective	Project manager did not initiate stop work/time out when unexpected conditions were identified (e.g., sloughing of coating inside drum). Less than adequate communication between project manager and workers regarding condition of drum.	Without use of stop work/time out process, unexpected conditions were not fully evaluated, and work continued.	**CF 5; GP 7**
B12.	Authorization Basis	Ineffective	NPTEC stored chemicals in a location not authorized by REOP, FEP, SEP, or FHA.	Compliance with facility documentation (e.g., REOP) would have precluded storage of chemicals at West Motel.	**CF 4; GP 7**

NOTE: CF = Core Function (of ISM); GP = Guiding Principle (of ISM).

APPENDIX C
Change Analysis

Table C-1. Change Analysis Listing

ID #	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect	Context: ISM
C1.	Contrary to MSDS requirements, IPA stored in the West Motel under excessive heat conditions	IPA stored per MSDS in a properly approved cool, well-ventilated location out of sunlight	NPTEC personnel did not comply with IPA storage requirements IPA was not stored in accordance with manufacturer current MSDS Storage location not approved by IH or REOP	Storage conditions allowed for formation of peroxides, which resulted in the explosion	**CF 2; GP 6**
C2.	All hazards associated with IPA not identified and controlled	All hazards identified and controlled Knowledge of chemical hazards kept current through most recent manufacturer MSDS NSTec has implemented a chemical management program overseen by a Chemical Safety AHJ Facility has implemented a robust chemical hygiene plan	No controls in place for legacy IPA Facility and oversight personnel did not recognize the peroxide hazard	Legacy IPA was allowed to collect for a long period of time under unfavorable environmental conditions, which allowed for the formation of peroxides	**CF 2; GP 6**

Table C-1. Change Analysis Listing (continued)

ID #	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect	Context: ISM
C3.	NPTEC FM and PM communication was less than adequate	NPTEC FM and PM effectively communicate with each other for completion of NSTec goals NPTEC organizational changes facilitate effective facility operations Surplus chemicals managed in accordance with company chemical management program	PM/FM relationship led to an unhealthy tension between NOD and GS Lack of coordination Legacy chemicals, including IPA, allowed to accumulate	Communication barriers between NOD and GS NPTEC personnel, R2A2 not clearly defined Ownership of legacy chemicals not clear Management of chemical disposition not effective	**CF 5; GP 1**
C4.	NPTEC Facility/Project organizational changes resulted in reduction from six (6) to three (3) FTE and part-time oversight	Organizational changes, in accordance with a staffing analysis, would maintain appropriate minimum staffing for safe operation of facility	Inadequate staffing to maintain safe operation of facility	Reduced staffing resulted in part time oversight support from FM, supervisor, and ES&H personnel Facility deficiencies not identified or corrected due to time constraints and/or unavailability of personnel	**CF 1; GP 4**
C5.	GS and NOD are not managing NPTEC in an effective, integrated manner	NOD and GS working as an integrated team	Convoluted, unclear roles and responsibilities divided between Directorates Facility problems are not effectively addressed; implementation of CONOPS is less than adequate	Dysfunctional working relationships across Directorates Organizational rigor and formality not improved Executive management developed a false sense of security that operational rigor introduced by NOD at NPTEC was adequate	**CF 1; GP 2**

Table C-1. Change Analysis Listing (continued)

ID #	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect	Context: ISM
C6.	Not all assessment and oversight activities were effective, and not all identified issues were adequately managed	Assessment and oversight activities are comprehensive and rigorous and results are managed adequately	Federal and corporate oversight did not identify deficiencies regarding management of chemicals at NPTEC FHA and HHE did not correctly address storage of chemicals at the West Motel. Deficiencies identified during other assessment activities were not effectively corrected and were, in some cases, put on hold due to perceived lack of funding	Legacy IPA continued to accumulate at West Motel, under unfavorable environmental conditions, contributing to the formation of peroxides	**CF 2; GP 6**
C7.	Chemical handling, including transfer, not identified in the scope of work	The work package addresses all chemical handling activities, including associated hazards and controls	NPTEC personnel performed hazardous work activities not addressed in the work package Perceived "skill of the worker" as adequate	NPTEC personnel performed chemical handling without specific knowledge of potential hazards and associated controls	**CF 4; GP 6**

NOTE: CF = Core Function (of ISM); GP = Guiding Principle (of ISM).

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APPENDIX D
Causal Factors and Related Conditions

Table D-1. Root and Contributing Causes

Root Cause #1: The safety culture at NPTEC did not facilitate the effective identification and resolution of problems.
◆ Personnel were reluctant to raise concerns, due in part to lack of effective resolution from previous attempts to address problems. ◆ Issues, such as concerns with bulk storage of aging chemicals, were assigned the lowest possible priority, or actions deferred, due to lack of funding. ◆ NSTec Senior Management did not effectively flow down their desired cultural values to first line supervisors who would in turn influence the behaviors of subordinates. ◆ No effective communication vehicle was used to elevate concerns regarding bulk storage of aging chemicals to higher levels of management. ◆ Complacency by both NSTec and NNSA/NFO resulted in ineffective oversight. ◆ NSTec management did not demonstrate shared ownership to improve the organization as a whole and personnel were empowered to avoid rendering decisions. ◆ The WFO Model established an environment whereby process improvements (e.g., development of NPTEC Chemical Hygiene Plan, facility infrastructure upgrades) were not implemented, based upon a perception of not being supported by WFO customers. ◆ NPTEC personnel have lost confidence in use of the MAXIMO system for correcting maintenance problems. ◆ Cultural norms at the NPTEC facility resulted in multiple assessments/evaluations (e.g., FWIP, FHA, HHE) being conducted without a walk-down of the facility. ◆ The current culture did not fully embrace and implement the principles of DOE O 422.1, which enabled subtle disregard for use of procedures. ◆ Practices such as storing drums in the heat, storing incompatible materials together, and leaving the lid off drums to allow material to evaporate reflected a culture of indifference to chemical hazards.
Root Cause #2: NSTec failed to fully implement formality and operational rigor necessary for managing and operating NPTEC.
◆ Chemical management responsibilities were not clearly defined or effectively implemented. ◆ NPTEC operations were not adequately staffed or managed to ensure effective implementation and control of activities. ◆ NSTec has not required establishment of “authorization basis” documentation, or equivalent, to ensure Moderate Hazard Facilities are operated in a safe and compliant manner. ◆ The work package did not address transfer of chemicals into release vessels, chemical handling, or chemical movement/storage.

Table D-1. Root and Contributing Causes (continued)

Root Cause #2 (cont.): NSTec failed to fully implement formality and operational rigor necessary for managing and operating NPTEC.
◆ NPTEC operations were not consistently governed by comprehensive procedures. ◆ Limited NOD management presence hindered the ability to achieve effective CONOPS implementation.
Root Cause #3: NSTec did not effectively manage chemicals in a safe and compliant manner, including the disposition of legacy chemicals.
◆ NSTec does not have a comprehensive company-wide chemical management program. ◆ NSTec did not adequately implement corrective actions to address existing chemical issues. ◆ NSTec does not have a Chemical Safety AHJ, or equivalent individual, responsible for enforcing chemical safety requirements. ◆ NSTec does not have a comprehensive chemical inventory tracking system that provides “cradle to grave” monitoring capability, including user alerts regarding expiration dates. ◆ NSTec has not developed a Chemical Hygiene Plan for NPTEC. ◆ The NPTEC West Motel was not authorized for storage of flammable/combustible substances. ◆ NPTEC MSDSs were not current and did not identify hazards associated with explosive peroxide formation. ◆ A hazards analysis was not performed to ensure adequate protection of chemicals stored in the NPTEC West Motel. ◆ Activity-level hazard identification and analysis was not effective in identifying all hazards associated with chemicals, including the formation of explosive peroxides in isopropyl alcohol. ◆ Chemicals of unknown origin, and/or unknown content, were stored at the NPTEC West Motel for several years. ◆ Chemicals were routinely stored under conditions not consistent with MSDS requirements (i.e., high temperatures, exposure to direct sunlight and the atmosphere, containers vented versus being tightly sealed). ◆ Required periodic ES&H inspections (i.e., housekeeping in storage areas, labeling, and inventory) have not been consistently performed at NPTEC.
Contributing Cause #1: The transition of NPTEC facility management from GS to NOD created a false sense of security with respect to the formality of facility operations.
◆ GS and NOD did not work as an integrated team. ◆ NOD management did not provide ongoing feedback to effectively reinforce the desired behaviors and required actions to achieve anticipated increase in operational rigor. ◆ GS and NOD management promoted the concept of “Formality in the Workplace” in lieu of “Conduct of Operations,” thereby diluting the importance of a long-standing overall philosophy for achieving excellence in the operation of DOE facilities. ◆ GS and NOD did not fully establish ownership and accountability with respect to disposition of legacy chemicals.

Table D-1. Root and Contributing Causes (continued)

respect to the formality of facility operations.
◆ NSTec Senior Management was not aware of the adversarial relationship/unhealthy tension between GS and NOD that promoted a culture of indifference related to the storage of legacy chemicals. ◆ NSTec and NNSA/NFO Senior Management placed high reliance on inaccurate/incomplete management feedback as indicators of satisfactory performance.
Contributing Cause #2: NPTEC Facility and Program organizations did not effectively manage issues.
◆ On occasion, RMs made non-conservative decisions when addressing issues due to time or resource constraints, resulting in corrective actions that address the immediate problem without consideration of the systemic or programmatic causes. ◆ Based on direction from NOD management, a Facility Oversight Assessment of NPTEC conducted in 2012 was not processed in accordance with procedural requirements (e.g., no unique identifier assigned, planned assessment not posted on the joint assessment schedule), resulting in approximately 30% of the assessment findings not being captured in the NSTec issues management system. ◆ In some instances, significant programmatic weaknesses generated from assessments were assigned the lowest possible priority or placed on hold due to lack of funding.
Contributing Cause #3: NSTec and NNSA/NFO processes did not enable risk informed decision making regarding operation and maintenance of NPTEC.
◆ NPTEC oversight (facility, project, safety management programs, federal) did not fully recognize hazards associated with storing bulk chemicals in the West Motel. ◆ Latent hazards associated with bulk storage of legacy chemicals at the West Motel were not fully understood and addressed by management. ◆ NOD has not established minimum criteria for operation and maintenance of NOD Moderate Hazard Facilities such as NPTEC. ◆ Placing issues “On Hold” precludes consistent identification and evaluation of potential risks at the corporate level. ◆ Despite two separate requests to dispose of legacy chemicals at NPTEC, perceived funding limitations resulted in no action being taken.

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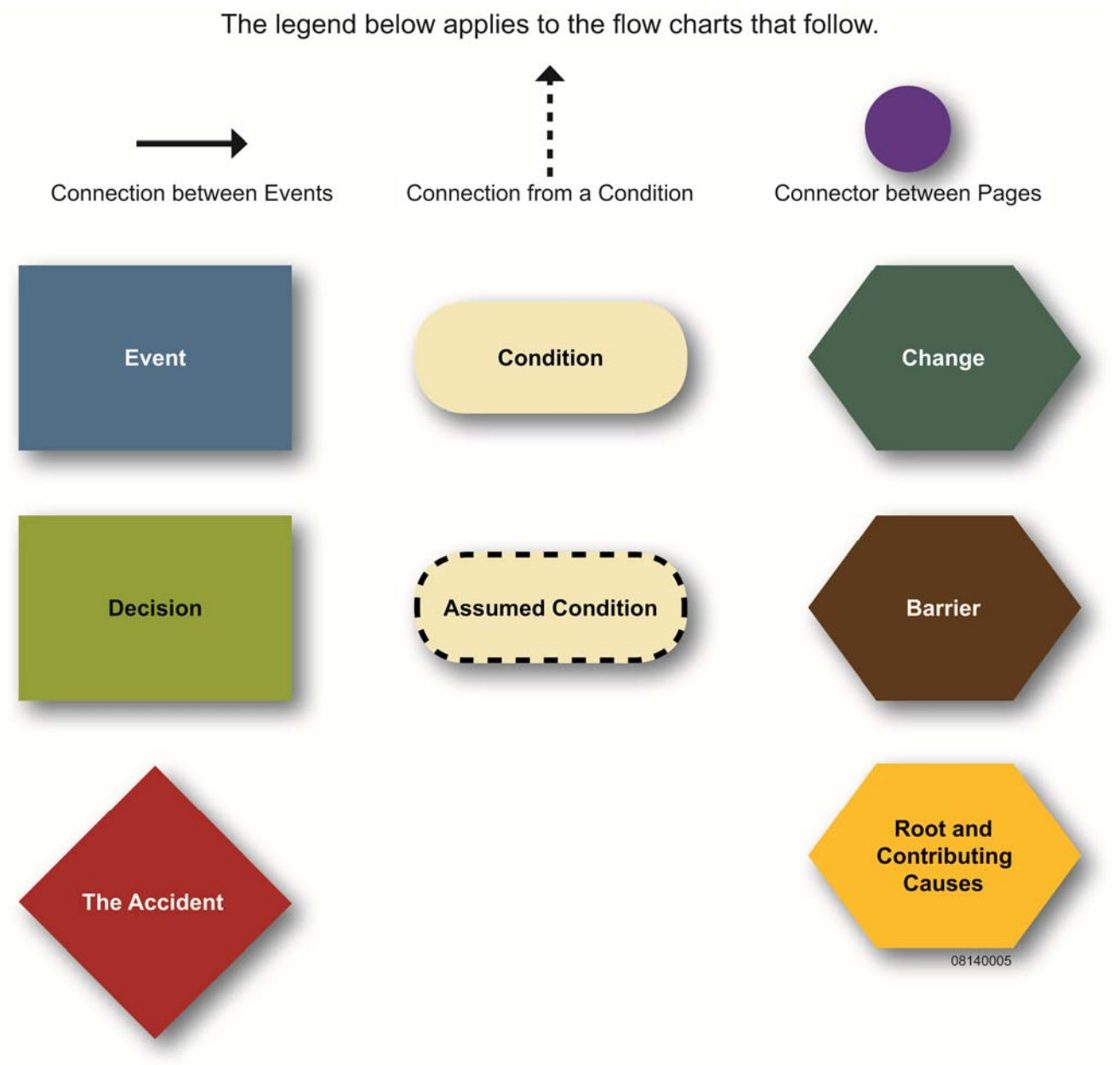
APPENDIX E
Event and Causal Factors Analysis



ACRONYMS	
AHIC	Activity Hazard Identification Checklist
CONOPS	Conduct of Operations
F&R	Fire and Rescue
GS	Global Security Directorate
HCl	Hydrochloric Acid
HS&DA	Homeland Security and Defense Applications
HSI	Hazardous Substance Inventory
IC	Incident Commander
IPA	Isopropyl Alcohol
JHA	Job Hazard Analysis
LED	Local Emergency Director
NCNS	National Center for Nuclear Security
NCSO	Nye County Sheriff's Office
NOD	Nuclear Operations Directorate
NPTEC	Nonproliferation Test and Evaluation Complex
OCC	Operations Command Center
OP	Organization Procedure
PTHR	Pre-Task Hazard Review
SCBA	Self-Contained Breathing Apparatus
SOP	Standard Operating Procedure
UMC	University Medical Center
WFO	Work for Others
WP	Work Package

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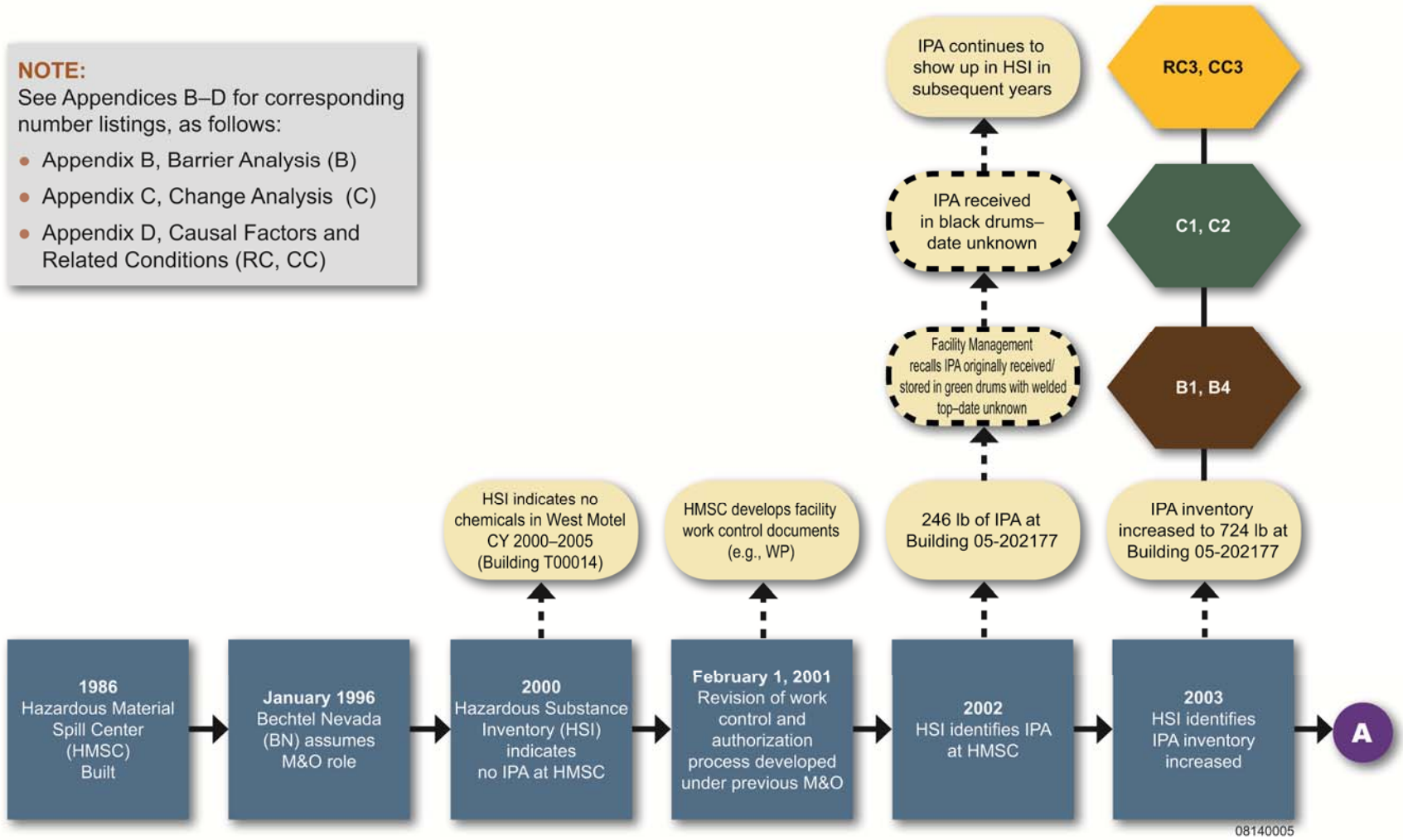
NOTE:
See Appendices B–D for corresponding number listings, as follows:
Appendix B, Barrier Analysis (B)
Appendix C, Change Analysis (C)
Appendix D, Causal Factors and Related Conditions (RC, CC)
1986 Hazardous Material Spill Center (HMSC) Built
January 1996 Bechtel Nevada (BN) assumes M&O role
2000 Hazardous Substance Inventory (HSI) indicates no IPA at HMSC
HSI indicates no chemicals in West Motel CY 2000–2005 (Building T00014)
February 1, 2001 Revision of work control and authorization process developed under previous M&O
HMSC develops facility work control documents (e.g., WP)
2002 HSI identifies IPA at HMSC
246 lb of IPA at Building 05-202177
Facility Management recalls IPA originally received/ stored in green drums with welded top–date unknown
IPA received in black drums– date unknown
IPA continues to show up in HSI in subsequent years
2003 HSI identifies IPA inventory increased
IPA inventory increased to 724 lb at Building 05-202177
B1, B4
C1, C2
RC3, CC3
A
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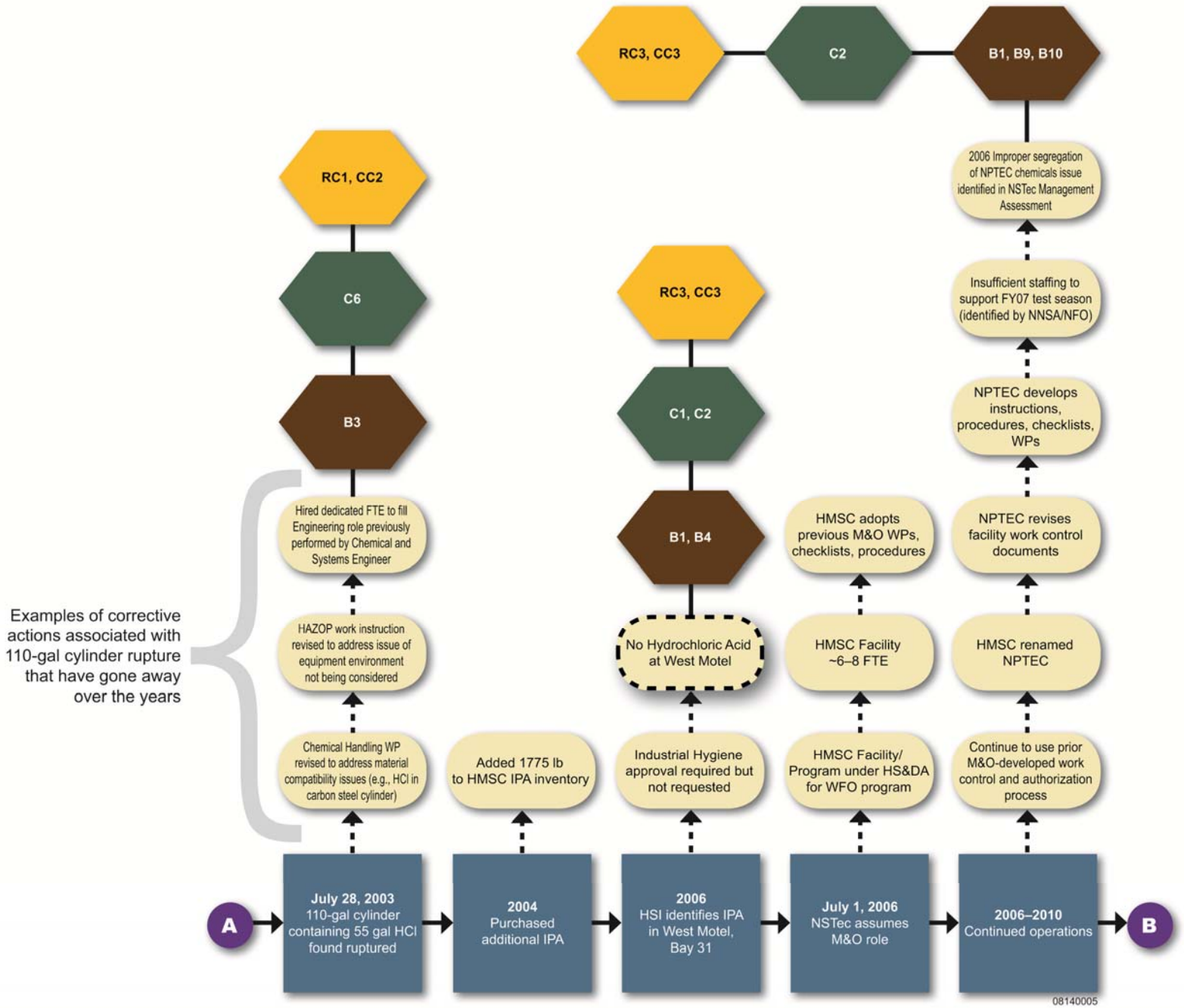
RC3, CC3
C2
B1, B9, B10
2006 Improper segregation of NPTEC chemicals issue identified in NSTec Management Assessment
Insufficient staffing to support FY07 test season (identified by NNSA/NFO)
NPTEC develops instructions, procedures, checklists, WPs
NPTEC revises facility work control documents
HMSC renamed NPTEC
Continue to use prior M&O-developed work control and authorization process
RC1, CC2
C6
B3
Hired dedicated FTE to fill Engineering role previously performed by Chemical and Systems Engineer
HAZOP work instruction revised to address issue of equipment environment not being considered
Chemical Handling WP revised to address material compatibility issues (e.g., HCl in carbon steel cylinder)
RC3, CC3
C1, C2
B1, B4
No Hydrochloric Acid at West Motel
HMSC adopts previous M&O WPs, checklists, procedures
HMSC Facility ~6–8 FTE
HMSC Facility/ Program under HS&DA for WFO program
Examples of corrective actions associated with 110-gal cylinder rupture that have gone away over the years
A
July 28, 2003
110-gal cylinder containing 55 gal HCl found ruptured
2004
Purchased additional IPA
Added 1775 lb to HMSC IPA inventory
2006
HSI identifies IPA in West Motel, Bay 31
Industrial Hygiene approval required but not requested
July 1, 2006
NSTec assumes M&O role
2006–2010
Continued operations
B
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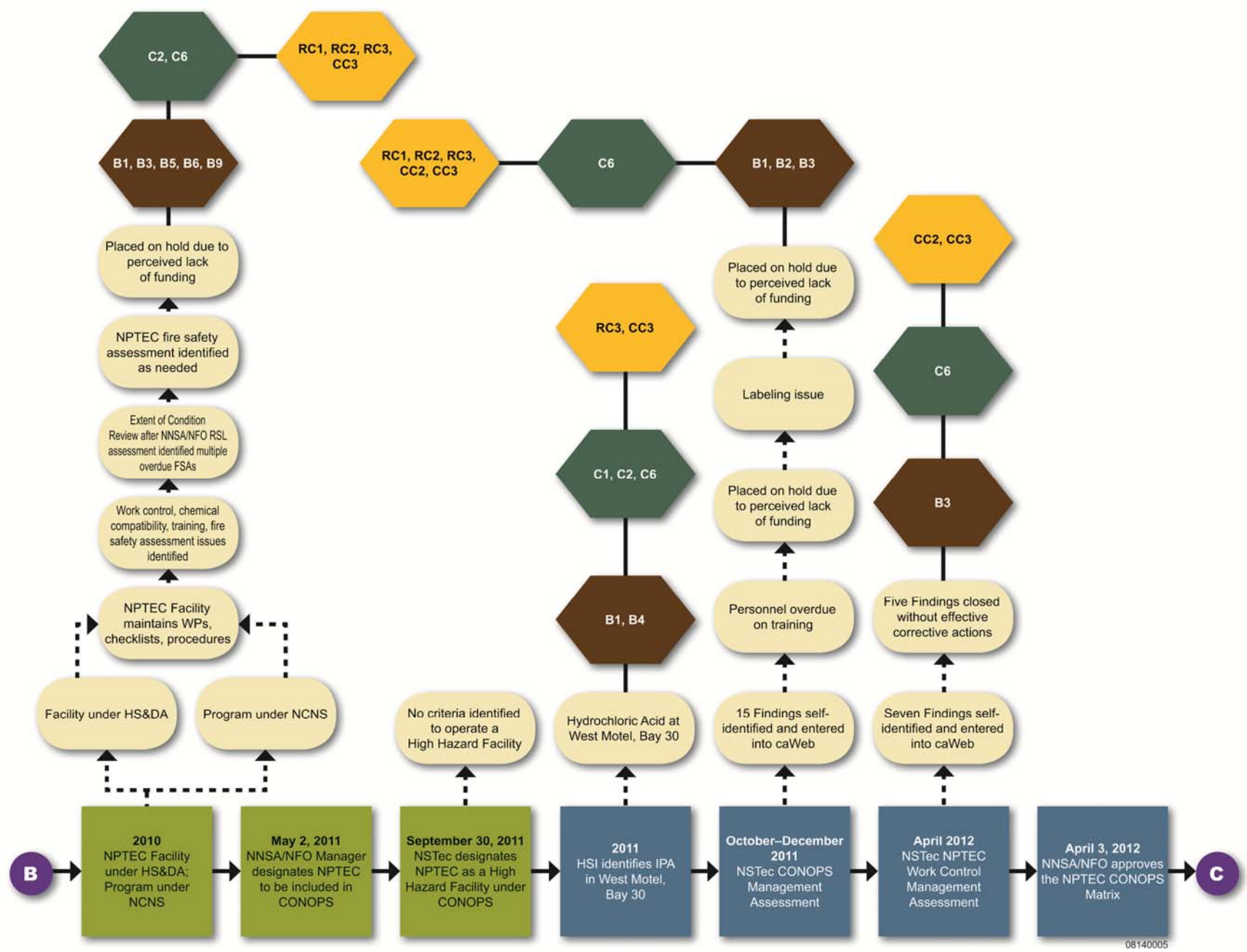
B
2010
NPTEC Facility under HS&DA; Program under NCNS
May 2, 2011
NNSA/NFO Manager designates NPTEC to be included in CONOPS
September 30, 2011
NSTec designates NPTEC as a High Hazard Facility under CONOPS
2011
HSI identifies IPA in West Motel, Bay 30
October–December 2011
NSTec CONOPS Management Assessment
April 2012
NSTec NPTEC Work Control Management Assessment
April 3, 2012
NNSA/NFO approves the NPTEC CONOPS Matrix
C
Facility under HS&DA
Program under NCNS
NPTEC Facility maintains WPs, checklists, procedures
Work control, chemical compatibility, training, fire safety assessment issues identified
Extent of Condition Review after NNSA/NFO RSL assessment identified multiple overdue FSAs
NPTEC fire safety assessment identified as needed
Placed on hold due to perceived lack of funding
B1, B3, B5, B6, B9
C2, C6
RC1, RC2, RC3, CC3
No criteria identified to operate a High Hazard Facility
B1, B4
C1, C2, C6
RC3, CC3
Hydrochloric Acid at West Motel, Bay 30
Personnel overdue on training
Placed on hold due to perceived lack of funding
Labeling issue
Placed on hold due to perceived lack of funding
B1, B2, B3
C6
RC1, RC2, RC3, CC2, CC3
15 Findings self-identified and entered into caWeb
Five Findings closed without effective corrective actions
B3
C6
CC2, CC3
Seven Findings self-identified and entered into caWeb
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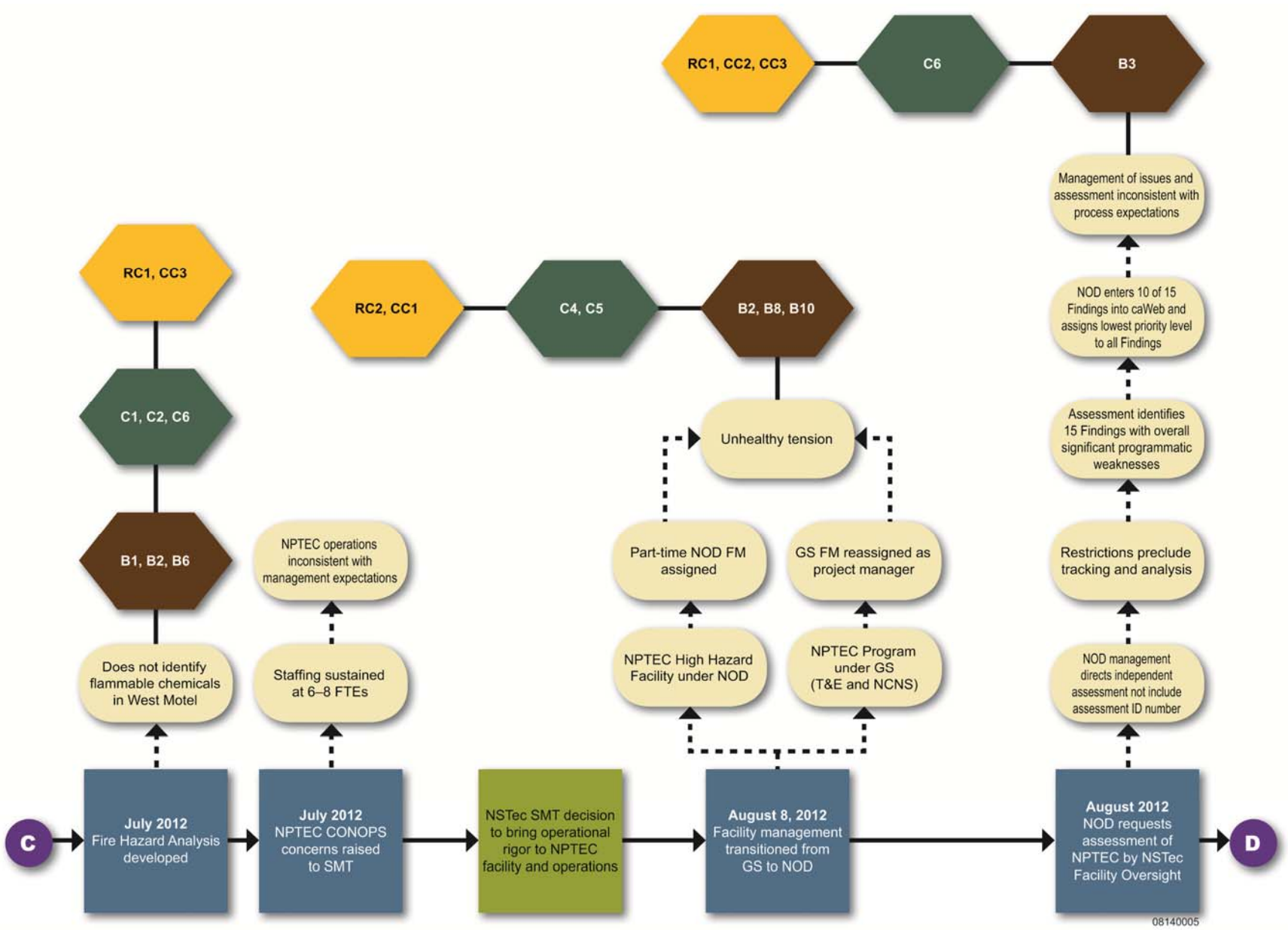
RC1, CC2, CC3
C6
B3
Management of issues and assessment inconsistent with process expectations
NOD enters 10 of 15 Findings into caWeb and assigns lowest priority level to all Findings
Assessment identifies 15 Findings with overall significant programmatic weaknesses
Restrictions preclude tracking and analysis
NOD management directs independent assessment not include assessment ID number
RC1, CC3
C1, C2, C6
B1, B2, B6
Does not identify flammable chemicals in West Motel
RC2, CC1
C4, C5
B2, B8, B10
Unhealthy tension
NPTEC operations inconsistent with management expectations
Staffing sustained at 6–8 FTEs
Part-time NOD FM assigned
GS FM reassigned as project manager
NPTEC High Hazard Facility under NOD
NPTEC Program under GS (T&E and NCNS)
C
July 2012
Fire Hazard Analysis developed
July 2012
NPTEC CONOPS concerns raised to SMT
NSTec SMT decision to bring operational rigor to NPTEC facility and operations
August 8, 2012
Facility management transitioned from GS to NOD
August 2012
NOD requests assessment of NPTEC by NSTec Facility Oversight
D
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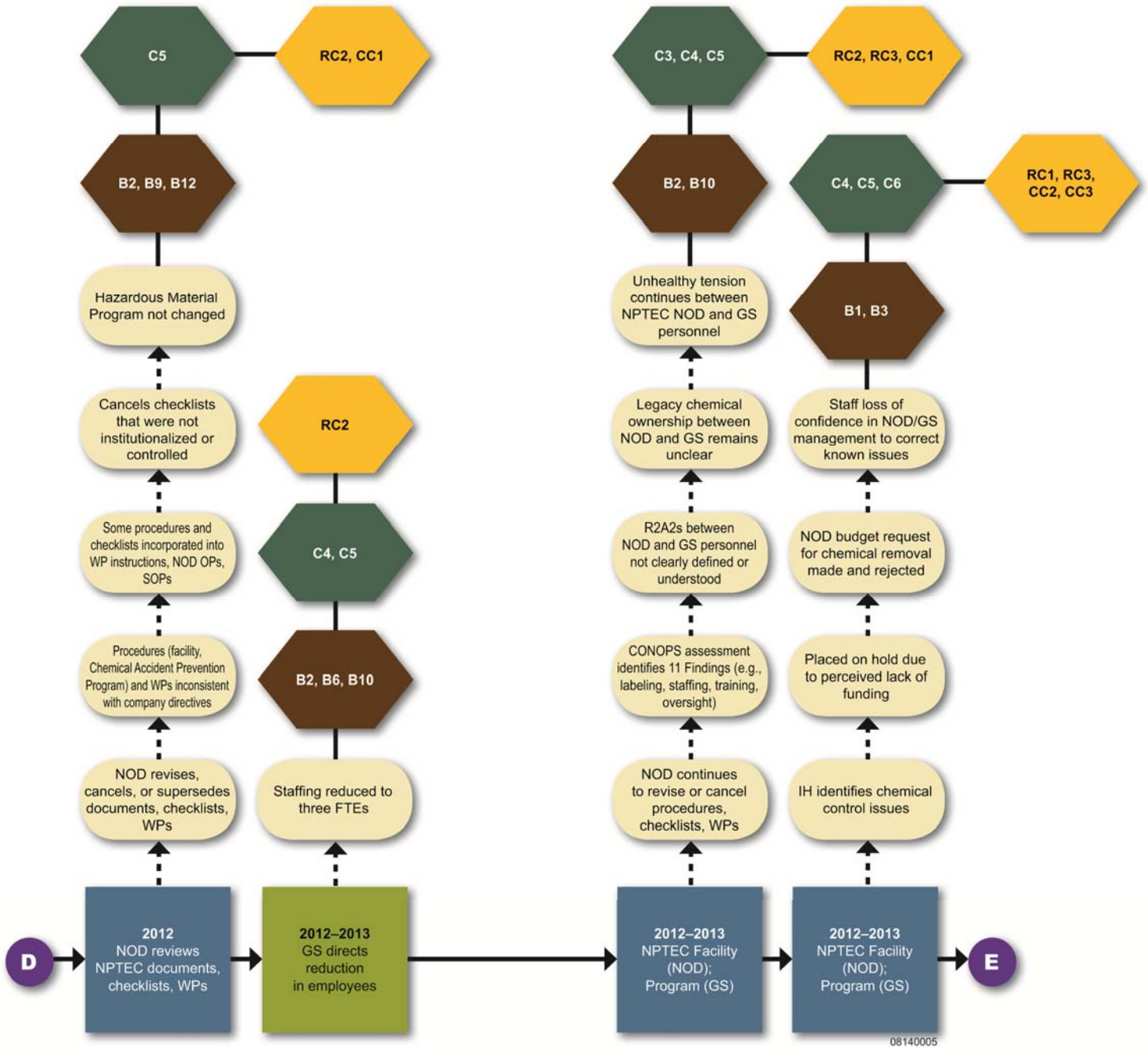
C5
RC2, CC1
B2, B9, B12
Hazardous Material Program not changed
Cancels checklists that were not institutionalized or controlled
RC2
Some procedures and checklists incorporated into WP instructions, NOD OPs, SOPs
C4, C5
Procedures (facility, Chemical Accident Prevention Program) and WPs inconsistent with company directives
B2, B6, B10
NOD revises, cancels, or supersedes documents, checklists, WPs
Staffing reduced to three FTEs
D
2012
NOD reviews NPTEC documents, checklists, WPs
2012–2013
GS directs reduction in employees
C3, C4, C5
RC2, RC3, CC1
B2, B10
C4, C5, C6
RC1, RC3, CC2, CC3
Unhealthy tension continues between NPTEC NOD and GS personnel
B1, B3
Legacy chemical ownership between NOD and GS remains unclear
Staff loss of confidence in NOD/GS management to correct known issues
R2A2s between NOD and GS personnel not clearly defined or understood
NOD budget request for chemical removal made and rejected
CONOPS assessment identifies 11 Findings (e.g., labeling, staffing, training, oversight)
Placed on hold due to perceived lack of funding
NOD continues to revise or cancel procedures, checklists, WPs
IH identifies chemical control issues
2012–2013
NPTEC Facility (NOD); Program (GS)
2012–2013
NPTEC Facility (NOD); Program (GS)
E
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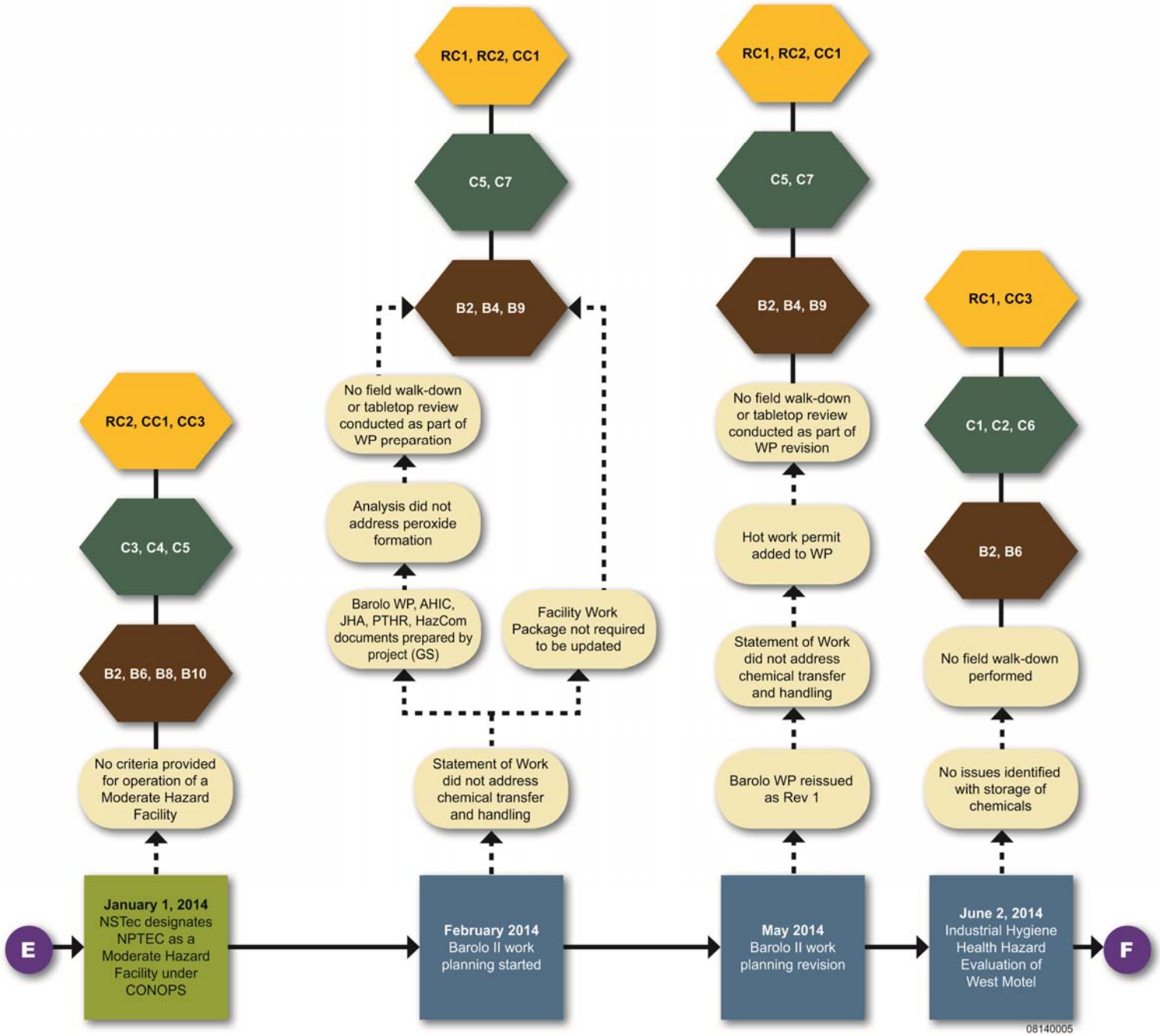
E
January 1, 2014
NSTec designates NPTEC as a Moderate Hazard Facility under CONOPS
RC2, CC1, CC3
C3, C4, C5
B2, B6, B8, B10
No criteria provided for operation of a Moderate Hazard Facility
February 2014
Barolo II work planning started
RC1, RC2, CC1
C5, C7
B2, B4, B9
No field walk-down or tabletop review conducted as part of WP preparation
Analysis did not address peroxide formation
Barolo WP, AHIC, JHA, PTHR, HazCom documents prepared by project (GS)
Facility Work Package not required to be updated
Statement of Work did not address chemical transfer and handling
May 2014
Barolo II work planning revision
RC1, RC2, CC1
C5, C7
B2, B4, B9
No field walk-down or tabletop review conducted as part of WP revision
Hot work permit added to WP
Statement of Work did not address chemical transfer and handling
Barolo WP reissued as Rev 1
June 2, 2014
Industrial Hygiene Health Hazard Evaluation of West Motel
RC1, CC3
C1, C2, C6
B2, B6
No field walk-down performed
No issues identified with storage of chemicals
F
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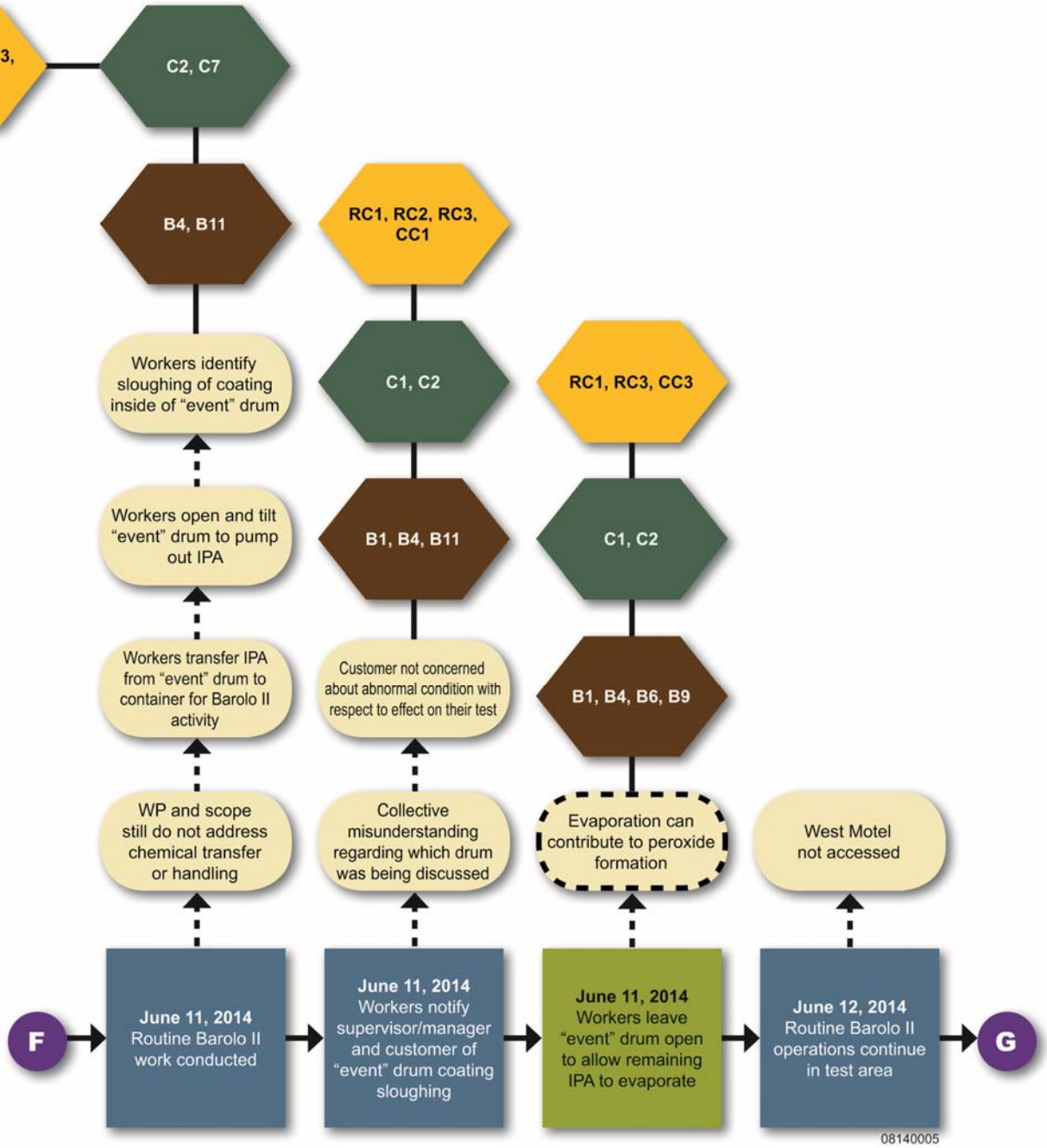
RC1, RC2, RC3, CC1
C2, C7
B4, B11
Workers identify sloughing of coating inside of "event" drum
Workers open and tilt "event" drum to pump out IPA
Workers transfer IPA from "event" drum to container for Barolo II activity
WP and scope still do not address chemical transfer or handling
RC1, RC2, RC3, CC1
C1, C2
B1, B4, B11
Customer not concerned about abnormal condition with respect to effect on their test
Collective misunderstanding regarding which drum was being discussed
RC1, RC3, CC3
C1, C2
B1, B4, B6, B9
Evaporation can contribute to peroxide formation
West Motel not accessed
F
June 11, 2014 Routine Barolo II work conducted
June 11, 2014 Workers notify supervisor/manager and customer of "event" drum coating sloughing
June 11, 2014 Workers leave "event" drum open to allow remaining IPA to evaporate
June 12, 2014 Routine Barolo II operations continue in test area
G
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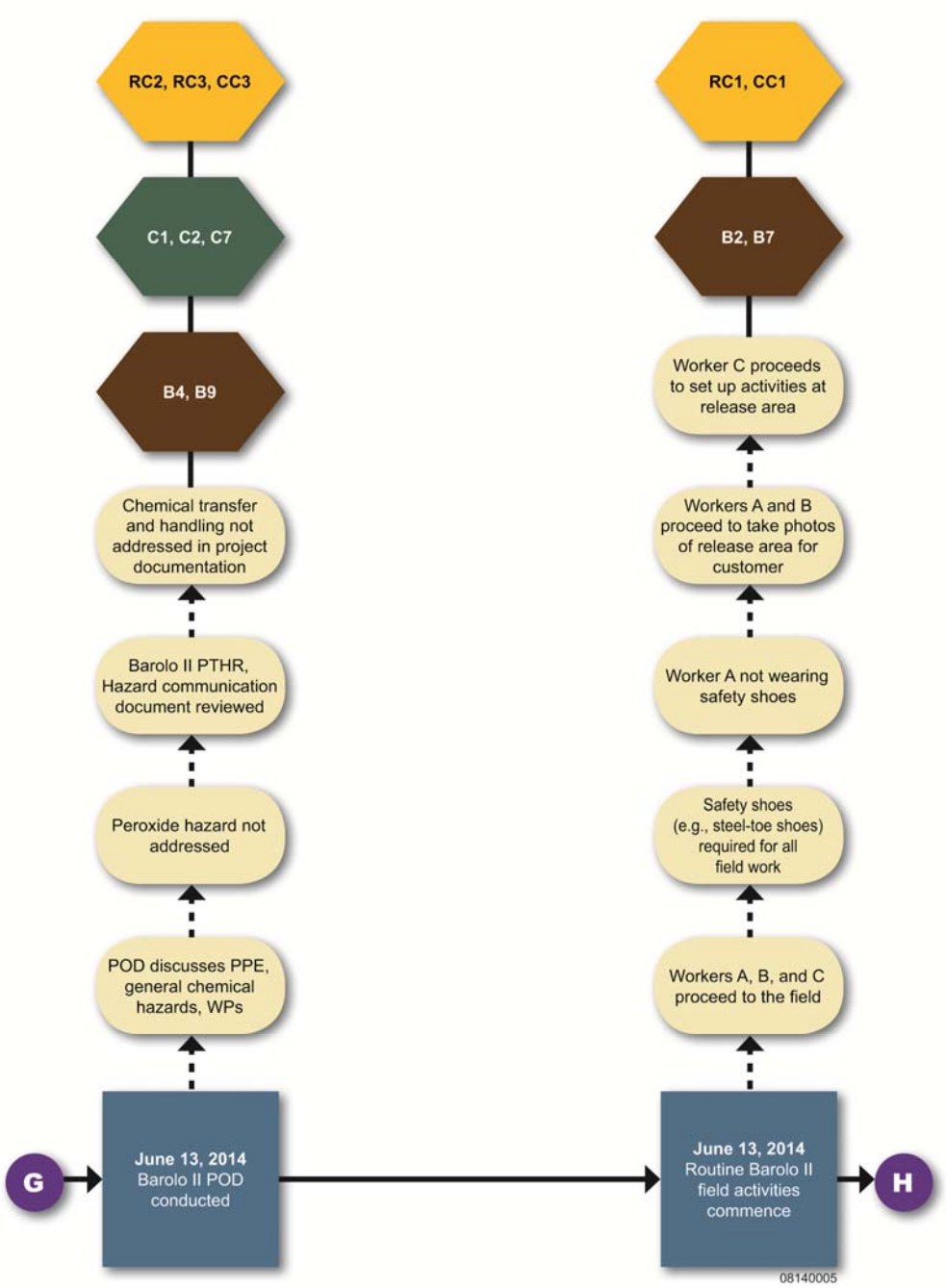
RC2, RC3, CC3
C1, C2, C7
B4, B9
Chemical transfer and handling not addressed in project documentation
Barolo II PTHR, Hazard communication document reviewed
Peroxide hazard not addressed
POD discusses PPE, general chemical hazards, WPs
G
June 13, 2014
Barolo II POD conducted
RC1, CC1
B2, B7
Worker C proceeds to set up activities at release area
Workers A and B proceed to take photos of release area for customer
Worker A not wearing safety shoes
Safety shoes (e.g., steel-toe shoes) required for all field work
Workers A, B, and C proceed to the field
June 13, 2014
Routine Barolo II field activities commence
H
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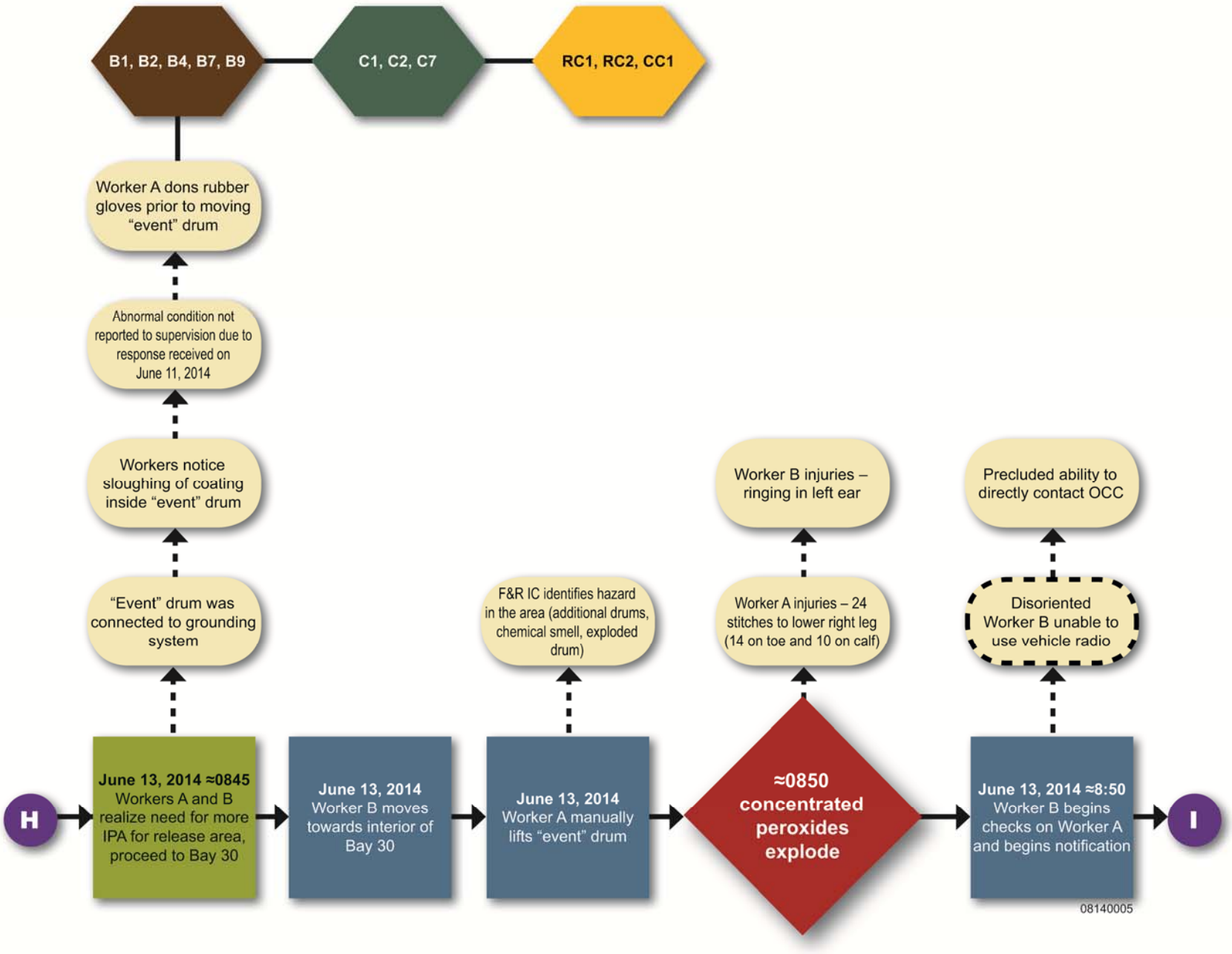
B1, B2, B4, B7, B9
C1, C2, C7
RC1, RC2, CC1
Worker A dons rubber gloves prior to moving "event" drum
Abnormal condition not reported to supervision due to response received on June 11, 2014
Workers notice sloughing of coating inside "event" drum
"Event" drum was connected to grounding system
H
June 13, 2014 ≈0845 Workers A and B realize need for more IPA for release area, proceed to Bay 30
June 13, 2014 Worker B moves towards interior of Bay 30
June 13, 2014 Worker A manually lifts "event" drum
F&R IC identifies hazard in the area (additional drums, chemical smell, exploded drum)
≈0850 concentrated peroxides explode
Worker A injuries – 24 stitches to lower right leg (14 on toe and 10 on calf)
Worker B injuries – ringing in left ear
Disoriented Worker B unable to use vehicle radio
Precluded ability to directly contact OCC
June 13, 2014 ≈8:50 Worker B begins checks on Worker A and begins notification
I
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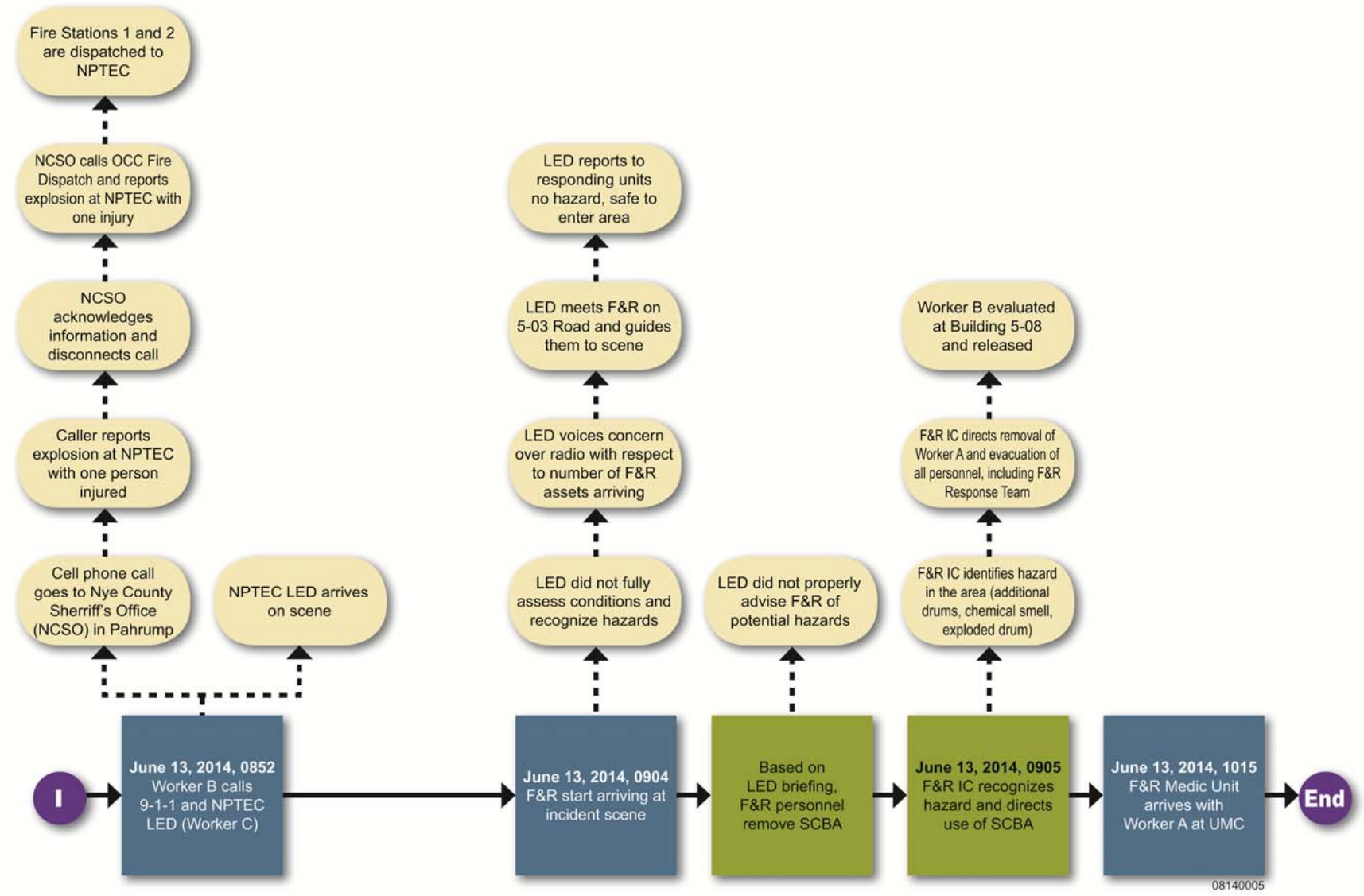
Fire Stations 1 and 2 are dispatched to NPTEC
NCSO calls OCC Fire Dispatch and reports explosion at NPTEC with one injury
NCSO acknowledges information and disconnects call
Caller reports explosion at NPTEC with one person injured
Cell phone call goes to Nye County Sherriff's Office (NCSO) in Pahrump
NPTEC LED arrives on scene
I
June 13, 2014, 0852 Worker B calls 9-1-1 and NPTEC LED (Worker C)
LED reports to responding units no hazard, safe to enter area
LED meets F&R on 5-03 Road and guides them to scene
LED voices concern over radio with respect to number of F&R assets arriving
LED did not fully assess conditions and recognize hazards
June 13, 2014, 0904 F&R start arriving at incident scene
LED did not properly advise F&R of potential hazards
Based on LED briefing, F&R personnel remove SCBA
Worker B evaluated at Building 5-08 and released
F&R IC directs removal of Worker A and evacuation of all personnel, including F&R Response Team
F&R IC identifies hazard in the area (additional drums, chemical smell, exploded drum)
June 13, 2014, 0905 F&R IC recognizes hazard and directs use of SCBA
June 13, 2014, 1015 F&R Medic Unit arrives with Worker A at UMC
End
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APPENDIX F
Acronyms and Abbreviations

AAR	Annual Analysis Report
AB	Authorization Basis
ACA	apparent cause analysis
AFM	Alternate Facility Manager
AHIC	Activity Hazard Identification Checklist
AHJ	Authority Having Jurisdiction
ALW	activity-level work
ALWD	activity level work documents
AMNS	Assistant Manager for National Security
AMSO	Assistant Manager for Site Operations
AMSS	Assistant Manager for Safety and Security
BEEF	Big Explosives Experimental Facility
CAAT	Culture Assessment Action Team
CAEV	corrective action effectiveness validation
CAP	corrective action plan
CAS	Central Alarm Station
CAV	corrective action verification
CCD	Core Company Directive
CD	Company Directive
CF	Core Function (of ISM)
CHP	Chemical Hygiene Plan
CON	Conclusion
CPR	cardiopulmonary resuscitation
CSLM	Chemical Safety and Lifecycle Management
CST	Civil Support Team
DAF	Device Assembly Facility
DHS	Department of Homeland Security
DM	Duty Manager
DOE	Department of Energy
EAL	emergency action level
EFCOG	Energy Facility Contractors' Group
EMS	Environmental Management System
EOC	Emergency Operations Center
EoC	Extent of Condition
EP	Environmental Programs
EPHA	Emergency Hazards Planning Assessment
EPHS	Emergency Hazards Planning Survey
EPIP	Emergency Plan Implementing Procedure
ERG	Emergency Response Guidebook
ERO	emergency response organization
ES&H	Environment, Safety, and Health

FAR	Functional Area Representatives
FDW	Facility Data Warehouse
FEP	Facility Execution Plan
FHA	Fire Hazards Analysis
FM	Facility Manager
F&R	Fire and Rescue
FR	Facility Representative
FSA	Fire Safety Assessment
FTE	full-time equivalent (employee)
FWIP	Formal Workplace Inspection Program
FY	Fiscal Year
GP	Guiding Principle (of ISM)
GS	Global Security
HAZCOM	Hazard Communication
HAZMAT	hazardous material
HHE	Health Hazard Evaluation
HMSC	Hazardous Material Spill Center
HQ	Headquarters
HS&DA	Homeland Security and Defense Applications
HSI	Hazardous Substance Inventory
IA	Independent Assessment
IC	Incident Command (or Commander)
IH	Industrial Hygiene
IMC	Issues Management Coordinator
IO	Issue Originator
IPA	isopropyl alcohol
IRG	Initial Response Guide
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
IST	Issue Screening Team
IWCP	Integrated Work Control Process
JAS	Joint Assessment Schedule
JASPER	Joint Actinide Shock Physics Experimental Research (facility)
JHA	job hazard analysis
JON	Judgment of Need
LED	Local Emergency Director
LRQA	Lloyd's Register Quality Assurance
LVMPD	Las Vegas Metropolitan Police Department
MA	Management Assessment
MAR	Mission Area Representative
M&O	Management and Operating (contract)
MSDS	material safety data sheet

NEPA	National Environmental Policy Act
NCNS	National Center for Nuclear Security
NCSO	Nye County Sheriff's Office
NFPA	National Fire Protection Association
NNSA/NFO	National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NOD	Nuclear Operations Directorate
NPTEC	Nonproliferation Test and Evaluation Complex
NSTec	National Security Technologies, LLC
NvE	Nevada Enterprise
OAA	Operational Awareness Activity
OCC	Operations Command Center
OFI	opportunity for improvement
OP	Organization Procedure
ORPS	Occurrence Reporting and Processing System
PD	Program Description
PISA	Potential Inadequacy of the Safety Analysis
PL	Priority Level
PM	Project Manager
POD	Plan of the Day
POOC	Parent Organization Oversight Committee
POS CON	Positive Conclusion
PPE	personal protective equipment
PTHR	Pre-Task Hazard Review
PY	Company Policy
RCA	Root Cause Analysis
RCRA	Resource Conservation and Recovery Act
REOP	Real Estate Operations Permit
RM	Responsible Manager
SB	Safety Basis
SCBA	Self-Contained Breathing Apparatus
SEP	Support Execution Plan
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SOTW	Skill of the Worker
S/SCA	Safety/Security Culture Assessment
TSD	Treatment, Storage, or Disposal (facility)
UIC	Unified Incident Command
UMC	University Medical Center
WFO	Work For Others

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