

California State Lands Commission

Safety and Oil Spill Prevention Audit

Ellwood Onshore Facility

Venoco, Inc.



March 2008



EXECUTIVE SUMMARY

Executive Summary

Safety Audit of Ellwood Onshore Facility

The objective of the Safety Audit Program is to ensure that all oil and gas production facilities on State leases or granted lands as well as upland locations supporting these facilities are operated in a safe and environmentally sound manner complying with Federal, State, and Local codes/permits, as well as industry standards and practices.

Background

Venoco Inc. (Venoco), with corporate headquarters in Denver, CO and regional offices in Carpentaria, CA and Houston, TX is an independent oil and gas company engaged in developing and producing domestic oil and gas properties primarily in California and Texas. Venoco's California core operations are located in and around the Santa Barbara Channel and in the Sacramento Basin.

EOF, located in Goleta, CA is the onshore facility that processes the production from Venoco's Platform Holly offshore oil and gas production facility. Platform Holly is located approximately 2 miles offshore in the Santa Barbara Channel and produces from State Oil and Gas Leases PRC 3120 and PRC 3242.

Platform Holly was installed in 1966 and has a capacity for 30 wells. Platform Holly is currently producing approximately 3,200 barrels of oil per day (bopd), 9,800 barrels of water per day (bwpd), and three million cubic feet per day (3,000 MCFD) of natural gas.

EOF receives feeds of gas from Platform Holly via a 6" pipeline and crude oil / water emulsion via a separate 6" pipeline. The gas is chilled and condensed natural gas liquids (NGL's) are recovered and shipped by truck. Hydrogen sulfide (H₂S) is removed from the gas stream in the Locat Unit and elemental sulfur is recovered and shipped by truck. The gas is compressed, chilled and dehydrated using diethylene glycol. Liquefied petroleum gases (LPG's) are recovered, stabilized to remove light ends, and is also shipped by truck. The sweet gas passes through a membrane filter to remove residual carbon dioxide (CO₂) before delivery as sales gas to the 8" SOCAL pipeline. The crude oil / water emulsion is heated and separated into two liquid streams. The produced water is injected into a disposal well. The produced oil stream utilizes sweet gas to strip H₂S from the oil. The oil runs down to onsite surge and storage tanks before being pumped to the Ellwood Marine Terminal for shipment by barge.

Safety Audit Procedures

The Safety Audit followed established procedures to address five functional areas: Equipment and Functionality, Electrical, Technical, Administrative, and Human Factors. Venoco personnel assisted CSLC staff during field activities and through direct consultation during the audit. The electrical team was comprised of personnel from Power Engineering Services, Inc.

Safety Audit Results

The safety audit identified a total of 186 action items. No Priority One action items were found. Priority One action items indicates those items with a high risk potential for injury, oil spill, adverse environmental impacts, or significant property damage that would require correction within 30 days. There were 10 Priority Two action items that have moderate risk potential for injury, oil spill, adverse environmental impacts, or property damage and require correction within 120 days. Finally, there are 176 Priority Three action items identified which have a low risk potential for injury, oil spill, adverse environmental impacts, or property damage. These items normally include outdated drawings, manuals, and procedures and require correction within 180 days. The following table shows the Priority level and the nature of the Action Item as indicated by team:

**Action Items
 Priority**

Team	1	2	3	Total
ADMIN	0	0	16	16
EFI	0	6	132	138
ELECT	0	4	28	32
TECH	0	0	0	0
Total	0	10	176	186

The Equipment Functionality & Integrity Team accounted for 138 of the 186 Action Items or about 74%. By far, the majority of these items are Priority Three Action Items address changes not shown on mechanical drawings, physical conditions requiring maintenance, and an adequate level of labeling of tanks, piping, and equipment. The facility and equipment were predominately in proper operating condition. A number of the EFI action items concerned information that needed to be updated on Process and Instrumentation Drawings (P&IDs) and were assigned the lowest priority.

The external condition of tanks, pressure vessels, and piping and their paint coatings was observed to be in good condition and the firefighting and other emergency and spill response equipment were also observed to be in good order and adequately maintained except as noted by action items. Personal protective equipment was observed to be readily available and fully utilized, and Safety Programs appeared to be in place and effective.

The Electrical Team accounted for another 17% of the Action Item grand total and combined with the EFI Team, accounted for 91% of all Items. The number of electrical action items identified in this audit was notably lower than in audits for other similar production facilities. Several factors likely account for these favorable results. EOF is operated in compliance with PSM requirements.

Venoco's electrician/instrumentation personnel have demonstrated close attention to the extensive requirements in the National Electric Code (NEC) and California Electric Code (CEC). The facility control systems and safety shutdown systems met the American Petroleum Institute (API) Recommended Practice and the Mineral Resources Management Division (MRMD) requirements. Although no action items were cited, the Technical Team issued several recommendations. One specifically recommended that at the next HAZOP, Venoco include a Safety Integrity Level Analysis on their instrumentation systems using the new ANSI/ISA standards for instrumented safety systems.

Conclusion

When all the identified safety audit action items are addressed, EOF will be in full compliance with the MRMD regulations. The fact that there were no priority one action items and only 5% of the total items were Priority two items is significant. All Venoco personnel were very cooperative in conducting this audit and demonstrated cooperation and responsibility for safety and environmental protection. Venoco has also demonstrated a commitment to Safety and Pollution Prevention, and should be commended on their continued commitment to safety and protection of the environment.

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Introduction

1.0 INTRODUCTION:

1.1 Safety Audit Background:

The California State Lands Commission (CSLC) Mineral Resources Management Division (MRMD) staff is conducting detailed safety audits of operators and/or contractors. The objective of these safety audits is to ensure that all oil and gas production facilities on State leases or granted lands are operated in a safe and environmentally sound manner and comply with Federal, State, and local codes/permits, as well as industry standards and practices. The MRMD staff is tasked with providing for the prevention and elimination of any contamination or pollution of the ocean and tidelands, for the prevention of waste, for the conservation of natural resources, and for the protection of human health, safety and property by sections 6103, 6108, 6216, 6301, and 6873(d) of the Public Resources Code (PRC). These PRC sections provide authority for MRMD regulations as well as the existing inspection program and the safety audit program that augments it.

The Safety Audit Program was developed in response to PRC 8757 (a), which originated from the Lempert, Keene, and Seastrand Oil Spill Prevention Act. This legislation considered existing oil spill prevention programs inadequate in reducing the risk of significant discharges of petroleum into marine waters. This Act specifically required marine facilities to employ the best achievable technology or protection by stressing the prevention of oil spills. The Mineral Resources Management Division (MRMD) regularly inspects and monitors onshore and offshore oil production facilities, which ensures the best achievable protection of the public health, safety and the environment. The Safety Audit Program was established to augment the existing inspection program, further preventing oil spills and other accidents. The Safety Audit Program enhances prevention efforts thorough a review of facility design, maintenance, human factors, and other areas.

The MRMD uses five teams, each with specific focus, to conduct the safety audit. The five teams systematically evaluate the facilities, operations, personnel, and management from many different perspectives. The five teams and their areas of emphasis include:

- 1) Equipment Functionality and Integrity (EFI)
- 2) Electrical (ELC)
- 3) Technical (TEC)
- 4) Administrative (ADM)
- 5) Human Factors (HF)

Appropriate company contacts and resources are identified for each team. Progress and inspection deficiency reports are communicated periodically throughout the audit evaluations. Each team records findings on an "action item matrix" for its area with recommended corrective actions and a priority ranking for the specified corrective action. Because of the overlap of functions, more than one team may identify some items, but, the duplication of findings across multiple teams has been reduced as much as possible.

The audit report highlights the findings of each team and the most significant action items and includes references to the complete matrix of action items. Draft copies of the audit report and the matrix of action items are provided to the company frequently throughout the

audit. The final audit report is provided to company management during a formal presentation of the results. The presentation affords the opportunity to discuss the findings and the corrective actions proposed in the final report. The MRMD continues to assist the operator in resolving the action items and tracks progress of the proposed corrective actions. Adjustments to the inspection program can be made based on the finding of the Safety Audit.

This program could not be successfully undertaken without the cooperation and support of the operating company. It is designed to benefit both the company and the State by reducing the risk of personnel or environmental accidents, damage, and in particular, oil spills. Previous experience shows that the safety assessments help increase operating effectiveness and efficiency and lower cost. History has shown that improving safety and reducing accidents makes good business sense.

1.2 Ellwood Onshore Facility History:

The Ellwood Onshore Facility (EOF) is located on the outskirts of the City of Goleta about 1200 feet from the Pacific Ocean and approximately 20 feet above sea level. The EOF was originally built in 1975 and was subsequently operated by ARCO, then Mobil. Venoco, Inc. purchased the facility and has operated it since 1997.

EOF is designed to receive the production from Platform Holly and the Seep Gas Recovery Tents from Santa Barbara Channel via sub-sea and buried onshore pipelines. Emulsion from Platform Holly is separated into gas, oil, and produced water, with the gas flowing to the Lo-Cat for hydrogen sulfide removal, the oil being treated for H₂S removal, and the produced water injected into the salt water disposal well. The separated oil is then shipped to the Ellwood Marine Terminal for loading to barges.

The facility is permitted to process 13,000 BPD oil and 13,000 MSCFD gas, although currently the production is 3,200 BPD oil and 3,000 MSCFD gas from Platform Holly and another 5,000 SCFD gas from the Seep Tents.

1.3 Operating Company History:

Venoco is an independent energy company primarily engaged in the acquisition, exploitation and development of oil and natural gas properties in California and Texas. It has regional headquarters in Carpinteria, California and in Houston, Texas and the corporate headquarters are in Denver, Colorado. Venoco operates three offshore platforms in the Santa Barbara Channel, has non-operating interests in three other platforms, and also operates two onshore properties in Southern California, approximately 250 natural gas wells in Northern California and more than 100 wells in Texas.

1.4 Ellwood Onshore Facility Description:

Oil and gas are produced from 30 wells on Platform Holly (two are currently being used as reinjection wells), separated, and sent through separate oil and gas pipelines to the EOF. On Holly, the gas portion is compressed, scrubbed and dehydrated and a portion is used for the gas lift in the production wells. The remaining gas is sent to EOF to be treated and sold a sales gas.

The EOF receives gas from Holly via a 6-inch pipeline operating at 100 psi and 70 degrees F and oil via a separate 6-inch pipeline operation at 60 psi and 100 degree F. Once the gas is chilled to -13 degrees F and sent through an inlet separator, the condensed natural gas liquids (NGLs) are recovered and stored in a 25,000 gallon bullet prior to being loaded onto trucks. The gas is filtered and desulfurized before being compressed in three stages to 980 psig.

Hydrogen sulfide is removed from the gas stream by direct contact with an aqueous chelated iron (LOCAT) solution. The rich solution is regenerated with sparged air, converting hydrogen sulfide to elemental sulfur, which is stored and loaded into trucks. The regenerated solution is recycled to desulphurization. After compression to 480 psig the gas is chilled to -25 degrees F and dehydrated using triethylene glycol. After water and liquefied petroleum gas (LPG) are removed, the pressure is increased to 980 psig before passing to a membrane unit to remove residual carbon dioxide and is delivered as sales gas to the 8-inch SOCAL pipeline at 975 psi.

The LPG is recovered in the dehydration unit by first being separated from the glycol, then stabilized to remove light ends, and piped to two 25,000 gallon storage bullets. The LPG is then loaded into trucks for transport.

Seep gas, recovered from two large tents placed on the ocean bottom, is also piped to and treated at the Ellwood facility. Once the gas is processed using iron sponge desulphurization, the seep gas joins the VRU gas and the Holly process gas stream at the compressor section's first stage.

The oil/water stream is heated to 150 degrees F; the water is separated from the oil and is injected into a disposal well. The hydrogen sulfide is stripped from the oil using sweet gas and the oil runs down to onsite crude oil surge tanks before being pumped to the Ellwood Marine Terminal. Vapors recovered from the hydrogen sulfide stripping, the produced water and the oil surge tanks is recovered and compressed back into the main gas stream for desulphurization.

The Marine Terminal is located 2 miles north of the EOF and is comprised of two 80,000 bbls capacity crude oil tanks and shipping pumps us to transfer the crude oil to an offshore barge mooring buoy where the crude oil is loaded to a dedicated barge. The terminal is manned only when transferring crude oil to the barge.

Refrigeration for the gas cooling process is provided by a propane refrigeration unit. Process heating is provided by use of a heat transfer fluid (Therminol) heated by waste gas. Hydrocarbon gas and vapor vented from the process is incinerated in a series of furnaces. In the event of emergency hydrocarbon vapors are burned in a ground flare.

The vapor recovery system consists of four compressors, VRU-1, VRU-2, VRU-3, and VRU-4, which are run two at a time in series, and collect gas vapors form various systems throughout the facility. More specifically, the first stage of the vapor recovery collect vapors from all zero to low pressure devices, such as the oil surge tanks, the hydrocarbon sump and the oil sump. The outlet of the back pressure control valves that maintain pressure on the LPG

and NGL tanks also connects to the first stage VRU. The collected vapors are than scrubbed in Suction Scrubber V-235 and compressed by either VRU-1 or VRU-3 to 25 psig and directed to the second stage of the vapor recovery. The second stage of vapor recovery collects vapors from the first stage, the crude oil heater treaters, and the H2S strippers. Here the vapors are scrubbed in Suction scrubber V-236 and compressed by either VRU-2 or VRU-4 to 50 psig, chilled to remove NGL, and finally added to the main sour gas flow prior to the inlet to Chiller E-222.

The produced water disposal system handles water produced in the oil processing system. The water settling tank (TK 201) serves as a surge tank for this water which has an elevated concentration of H2S and is continuously entering the tank from the heater treaters. Vapors in the tank exit to the first stage of the vapor recovery system.

The process drain system consists of two sumps: the crude oil sump and the process hydrocarbon sump. These sumps collect the oil and hydrocarbon drains from several systems throughout the facility and recycle the liquids back to heater treater HT-201 and HT-203.

Relief gas from various systems throughout the plant vent to the relief system. In the event of high pressure deviations, the gas will be sent tot the relief system through pressure safety valves. Once in the relief system, the gas is combusted in the Hirt Burners H-205 and H-206. If the pressure in the relief system continuers to rise, the relief gas cascades to open flare H-207.

***Equipment
Functionality &
Integrity Audit***

2.0 EQUIPMENT FUNCTIONALITY & INTEGRITY AUDIT

2.1 Goals and Methodology

The primary goal of the EF&I Team was to evaluate the physical condition and maintenance of Ellwood Onshore Facility (EOF) equipment, and review the supporting documentation. This was accomplished through a series of inspections that included the verification of Process Flow Diagrams (PFDs), Piping and Instrumentation Diagrams (P&IDs), and other key diagrams and plans. Inspection and evaluation was typically conducted on equipment on a system or category basis. The methodology incorporated is reflected in the layout of this report.

2.2 General Facility Conditions

2.2.1 Housekeeping: The EOF was relatively clean and appeared to be well maintained. All places of employment, passageways, storerooms, and service rooms are kept clean and orderly and in a sanitary condition. Workroom floors are maintained in a clean and, so far as possible, dry condition. Where wet processes are a hazard, drainage is maintained, and platforms, mats, are provided where practicable. Mechanical equipment aisles and passageways have sufficient safe clearances and are kept clear and in good repair with no obstructions. Adequate waste receptacles were located throughout the facility with specially marked yellow containers for drained oil filters and fluorescent bulbs.

The restrooms were found to clean and well maintained with one minor exception. The employee shower stalls were being used as a storage cubicle and not available to company and contract personnel. In the event of skin exposure to a hazardous material, the employee shower should be readily available to minimize the danger of skin absorption. The CSLC recommends that the employee shower stalls be emptied of scrap, bags, containers and equipment.

2.2.2 Stairs, Walkways, Gratings, and Ladders: The EOF has few stairs and a limited number of fixed ladders considering the size and layout of the facility. Those installed provide adequate access throughout the facility, are maintained in good condition, appear to be structurally sound, and seem properly equipped with handrails. Portable work ladders were stored on ladder racks. This helps eliminate tripping hazards posed by ladders, protects the ladders from damage, and makes them readily available for operating personnel. All of the fixed and portable ladders appeared to be reasonably clean and in good working order.

2.2.3 Escape / Emergency Egress / Exits: Due to the design, size, and open arrangement of the EOF, there were no areas of concern regarding access and egress. Emergency exits, escape routes and gathering points are all easily seen. However, the windsocks throughout the facility were deteriorated and in need of repair or replacement. (EFI - 2.2.3.02) Replacement of the windsocks is recommended since they provide instant recognition of wind direction and speed and they help determine safe assembly areas for personnel in the event of a hazardous material release.

2.2.4 Labels, Placards, and Signs: Studies have shown that a large portion of human errors can result from the design of the work environment. Clear labeling is one of the simplest ways to reduce selection errors and improve employee performance. While effective labeling may have been present when a facility is first built, these visual aids can be lost over time due to tearing off, painting over, be covered with insulation, or become outdated by changes in the equipment or process unless they are routinely maintained. When labels are missing, incorrect or misleading, workplace error becomes a higher risk and mistakes can occur.

Inadequate labeling was one of the most frequent problems encountered at the facility. Many of the action items generated were in response to missing or incorrect labeling. The labeling deficiencies included: missing hand switch positions on the pig receiver emergency shutdown valves resulting in a priority two action item, pump start/stop switches and control panels were not labeled resulting in several action items, missing identification tags on the K-201 compressor temperature and pressure sensors, and incorrect pipeline numbers displayed on the Zone 4 piping that transitions from pipe rack to underground. (EFI - 2.2.4.02 thru 08) Although Venoco's tanks and vessels have NFPA 704 diamonds to inform responders of the hazards of the material contained, the height of the lettering was often too small for the size of the vessel and could not easily be read at a distance. (EFI - 2.2.4.01) The numbers should be visible from a minimum distance of 50 ft. and there is a reference chart with recommended distance and letter height requirements within NFPA 704.

Confined spaces throughout the facility were properly identified with warning placards except for the K-201 compressor suction knockout. The knockout drum does not have a placard identifying it as a confined space area. (EFI - 2.2.3.01) Also, there were no emergency phone numbers posted at the facility entrance for emergency service providers or the general public. (EFI - 2.2.5.03)

The CSLC staff recommends standardizing the labeling throughout the facility by using the "ANSI Pipe Marking Standard A13.1", to identify the hazards within the workplace, to provide clear labeling. The use of this standard is appropriate both onshore as well as offshore.

2.2.5 Security: The EOF appears reasonably secure with chain link perimeter fencing topped with barbed wire to prevent unauthorized entry. The facility is manned twenty-four hours per day, three hundred sixty-five days per year. Entry of authorized personnel into the facility is controlled and monitored by facility personnel utilizing video surveillance and a controlled access gate at the main entrance. There appears to be an adequate number of signs warning the public against unauthorized entry, but there was a security concern at the gate to the golf course. The gate at the south end of the facility that opens to the adjoining golf course is typically left open during daylight hours. This could allow unauthorized access to the facility. Since this gate is not monitored, Venoco should evaluate this concern, particularly for heightened security alert periods to prevent unauthorized entry. (EFI - 2.2.5.02) Additional recommendations include the installation of physical vehicle barriers to protect the pipelines or piping next to the roadway by the heater treaters. (EFI - 2.2.5.01)

2.2.6 Hazardous Material Handling and Storage: The storage of flammable and combustible liquids at EOF appeared compliant with CAL-OSHA regulations and NFPA 30. Both the NGL and LPG tanks along with bulk chemical totes were observed to have proper placards, no leaks, and adequate containment in the event of a spill. However, there is concern that flammable materials are being stored in cabinets not approved for fire protection purposes. (EFI - 2.2.1.01) When considering the safe storage and handling of flammable and combustible liquids NFPA 30, Uniform Fire Code (UFC) Articles 79 and 80, or equivalent local codes should be used. Recommendations included checking with the local Fire Authority for compliance with the locally enforced code.

Compressed gas cylinders that were in use were properly secured; however, one minor exception was noted. A hydrogen gas cylinder was improperly stored alongside other nonflammable gas cylinders. (EFI - 2.2.6.01) Material Safety Data Sheets (MSDS) were present in the operations control room and chemical hazards in the workplace are identified and evaluated and that information concerning these hazards is communicated to employers and employees. This transfer of information is accomplished by means of a comprehensive hazard communication program, which includes container labeling and other forms of warning, Material Safety Data Sheets (MSDS) and employee training.

2.3 Field Verification of Piping and Instrumentation Diagrams (P&ID), Fire Main Drawings and Emergency Evacuation Site Plans

Process diagrams are grouped into two major categories: process flow diagrams (PFDs) and piping and instrument drawings (P&IDs). A flow diagram is a simple illustration that uses process symbols to describe the primary flow path through a unit. A process flow diagram provides a quick snapshot of the operating unit. Flow diagrams include all primary equipment and flows, and are often used for visitor information and new employee training.

2.3.1 Process Flow Diagrams (PFD): The EF&I Team conducted a comprehensive field review of EOF Process Flow Drawing (PFD) F-9749A, Revision #4 which was supplied by Venoco at the beginning of the audit. The PFD drawing appeared accurate with only a few minor exceptions. The Hydrogen Sulfide Strippers V-201 & V-202 were not shown on the PFD. In addition the PFD has not yet been revised to reflect the change in the gas lines leaving the Grace Membrane unit that supplies Platform Holly with sweet gas for the flare. (EFI - 2.3.1.01)

Regulation MRMD 2175(b)(9) requires that all production streams must be identified with information regarding chemical makeup, volumes, pressures, flow rates, temperatures, appearance and odor. This information is commonly incorporated into a material and flow balance table shown on the PFD. The failure to address this requirement resulted in a deficiency. (EFI - 2.3.1.02)

2.3.2 Piping and Instrumentation Diagrams (P&ID): Comprehensive field verifications of all P&IDs were performed for EOF. These drawings were reasonably accurate with minor discrepancies in some areas. Discrepancies included: sizing errors in valves, piping connections, and out of service or removed equipment. (EFI - 2.3.2.01 thru 93) The above process safety information is one of the elements used for identifying and understanding the hazards of a process and is necessary in developing the process hazard analysis and may be

necessary for complying with other provisions of PSM such as management of change and incident investigations.

2.3.3 Fire Protection Drawing Verification: The Fire Protection Equipment, ESDs, SCBAs, H₂S sensors, optical flame detectors, and LEL sensors for EOF were field verified for number and location accuracy. A review of the drawings revealed four minor discrepancies. Two of the discrepancies included the inaccurate location of optical flame detectors and LEL sensors. (EFI - 2.3.3.01 & 02) In addition, three fire extinguishers were not shown on the Fire Protection System. (EFI - 2.3.3.03) ESD devices were also not identified as shown in the legend. (EFI - 2.3.3.04)

2.4 Condition and Integrity of Major Systems

2.4.1 Piping: The condition of piping throughout EOF appeared to be good condition with no apparent leakage or coating failure. A review of the piping inspection records found that Venoco is utilizing both visual and ultra-sonic inspections as analytical methods for risk assessment. Coupons and chemical treatment are used to guard against internal corrosion as well as the corrosive effects of H₂S. In addition, the maintenance records reflect a proactive approach to evaluating the risk significance of degraded piping. Completed work orders were reviewed that showed the repair / replacement of questionable piping due to corrosion in part due to the H₂S environment. The interconnecting equipment (piping, valves, flanges, fittings, etc.) and material appear compatible with each other and the environment. Piping is carried on adjustable hangers or properly leveled rigid hangers or supports to prevent premature failure due to fatigue and/or sagging.

Piping deficiencies included a 2" fuel gas flange open ended to the atmosphere and missing car seals on several valves in the piping system. (EFI - 2.4.1.01 thru 04) In addition temporary repair clamps were found on the 2" firewater makeup line. (EFI - 2.4.1.05)

Piping identification and flow direction throughout the process facility is in need of improvement. Priority three action items regarding process lines and manifolds were generated because they are either lacking or missing identification and flow arrows to assist operating personnel in identifying lines and were addressed in section 2.2.4. Painted lettering on some of the piping was either incorrect or has become unreadable due to age and weathering. This condition requires operating personnel to rely on their memory or trace lines to accurately identify them. Major process lines and critical service valves should be identified to reduce the chances of human error during an undesirable event.

2.4.2 Tanks: The tanks are monitored and maintained following a program of external and internal examination. The external and internal inspection intervals for all tanks were analyzed for compliance with applicable regulations, recommended practices, and record keeping within a preventive maintenance system, API RP 12R1, 653. Process tanks and vessels are equipped with ASME required safety devices and will alarm locally or in some cases generate a computer alarm and/or alert.

Storage tanks at the facility were visually inspected for manufacturing defects and signs of service induced damage. Inspections and thickness measurements records for the storage tanks were also reviewed. The inspection/repair records indicate that Venoco is doing a good

job maintaining their tanks and adhering to API 653 standards and ASME code work with minor exceptions noted below. Coating failure was found on top of T-201 stairs. (EFI - 2.4.2.01) In addition, inspection records for T-203 did not have a "next" recommended U/T inspection date. (EFI - 2.4.2.02) Tank T-1903 was out of service for repair. Inspection records and planned repair information showed the tank bottom required renewal and this work was underway at the time of the audit. (EFI - 2.4.2.03)

The process tanks appeared to be equipped with safety devices and sensors that help prevent liquid overflow. The adequacy of the safety devices and liquid level sensors will be evaluated in the Technical Section.

2.4.3 Pressure Vessels: Pressure vessels are utilized in the storage and processing of produced hydrocarbons and to provide controlled liquid flow to downstream equipment. These vessels operate at pressure in excess of atmospheric pressure and are subject to corrosion, erosion, and environmental cracking. External / internal inspections provide the information necessary to determine that all the essential sections or components of the vessel are safe to operate. Internal examination is also the preferred method of inspection for significant localized corrosion and other types of damage.

An external examination was done to assess the general condition of the pressure vessels for specific problems such as instances of corrosion, erosion, and leakage. All vessel coatings were found to be in good condition with no blistering or flaking. The deficiencies noted were minor in nature and included a flange leak on an exchanger and improper foundation anchoring. (EFI - 2.4.3.01 & 03) Hairline cracks were observed in the external fire protection insulation of NGL storage vessel (V-227). (EFI - 2.4.3.02)

Inspection records, construction and maintenance logs, appeared to be current and well organized and are indicative of the surveillance activities to ensure the safe operation of facility pressure vessels with minor exceptions. Three ultrasonic reports were reviewed that require additional follow up. Ultrasonic reports, performed in January 2006 for the fresh water surge tank (V-242) and the glycol drip tank (V-210A), show a calculated remaining life of zero years. (EFI - 2.4.3.04 & 05) An ultrasonic report dated July 2005 for the intercooler receiver (V-245) on the York refrigeration unit shows a negative retirement date of March 2005. (EFI - 2.4.3.06)

Facility air receivers are subject to a program that includes external and internal examinations, which satisfy Cal OSHA regulations 461, 462, 465 & 466. The air receivers at EOF comply with existing regulations and have valid state issued permits. In addition, API guidelines and industry standards were followed with regard to inspection and maintenance of the instrument air system.

2.4.4 Pressure Relief and Vent / Flare System: The piping for the relief / flare system at EOF was evaluated for condition, maintenance, and functionality. Hydrocarbon and vapor vented from the process flow to a flare scrubber (V-221) for removal of any entrained liquid. Gas from the flare scrubber flows into a header system connected to two thermal oxidizers (H-205 & H-206) and a ground flare (H-207). Gas flow is regulated by pressure control. Should overpressure occur on the flare scrubber, two pressure relieving devices on the flare scrubber relieve into the section of the header system connected to H-206 and H-207.

Isolation valves on the relief system are provided for maintenance purposes. During normal operations these valves are open; however, they can be used to isolate a relief valve for inspection and/or repair while the facility is operating. Due to the critical nature of this safety system, these isolation valves should be locked or car sealed in the open position during normal operations. All isolation block valves were found to be car sealed or locked open. Analysis of the overall relief system design can be found in the Technical section 4.7.

The maintenance and servicing intervals for all pressure safety valves (PSVs) on the pressure vessels were examined and found to comply with applicable regulations and recommended standards, as well as, record keeping within a preventive maintenance system, MRMD 2132 (g)(3)(D) and 2175 (b)(5)(B), API RP 520, 521 and Cal OSHA 6551. To satisfy concerns raised in a hazards analysis, Venoco completed a PSV study in 2002 that verified that PSV's were sized for blocked flow and fire exposure. An outside contractor inspects PSV's on all pressure vessels throughout the facility. The frequency is yearly regardless of the service of the relief valve. Service records were in order with no action items identified.

2.4.5 Fire Detection: The fire detection system at EOF is designed to detect fires in their earliest stages and alert personnel to the existence of a fire. All fire alarms have their distinct tone and are broadcast over the facility address system in addition to being hard wired to the control room alarm panel as well as the Goleta Fire Department. Process areas where there is a potential for a flammable liquid spill are monitored using the following methods and techniques:

- Personal observation and surveillance
- Process monitoring equipment that would indicate that a spill or leak has occurred
- UV/IR detectors that continuously monitor the areas where facilities operations are unattended.

This fire detection system is comprised of 43 ultraviolet / infrared fire eye flame sensing detectors that will activate the fire suppression system and result in a shutdown of the facility. The flame detectors appeared to have an unobstructed, clear view of the fire threat area and were free of paint overspray, masking tape, etc. physically covering the detector's window viewing lens. Detector mounting brackets were also free of breakage or misalignment and appear properly oriented (aimed) at the fire threat area.

Facility personnel who observe a fire or an alarm may also manually initiate fire suppression before automatic sensing devices activate the fixed fire suppression deluge system. The condition of the fire detection system appears satisfactory.

2.4.6 Fire Suppression: EOF fire suppression system consists of a primary firewater pump with a 200 Horsepower electric motor and a backup firewater pump with a 200 Horsepower Detroit diesel. Both pumps were manufactured by the Aurora Pump Company and are rated at 1000 gallon per minute @ 1750 RPM. Pressure Maintenance Pump P-243 commonly referred to as a jockey pump maintains a constant pressure on the fire mains. The electric fire pump is set to auto start if the fire main pressure drops to 100 PSI, and the diesel fire pump is set to auto start if the fire main pressure drops to 45 PSI. City water for fire fighting is stored in two 3000 barrel fresh water tanks. In addition, a 6" four-way inlet (FDC) with a 4" supply line is located near the intersection of Hollister Avenue and the access road

leading to EOF (EOF). In the event of an emergency, the Fire Department can pump water into the quadramese (FDC) at the Hollister Avenue location to supplement the fire water supply.

Additional fire protection equipment includes:

- Fire hydrants
- 150-pound and 30-pound extinguishers
- Hose reels
- Carbon dioxide extinguishers
- Stationary monitors
- Foam system with monitors
- Deluge system

The equipment is located throughout the property with CO₂ extinguishers in enclosed electrical areas. A deluge system protects the two LPG / NGL bullet tanks in addition to their fire-proof insulation. A 1200 gallon foam concentrate tank V-225 is utilized to supply foam to fixed foam monitors and also to the oil storage tanks. Internal piping within the storage tanks is designed to allow a fire to be smothered with foam. The foam is tested annually to insure quality.

Testing of the primary firewater pump is performed weekly and the automatic spray systems are tested monthly as required by CSLC regulations. All fire protection equipment appeared to be properly maintained, and periodic inspections and tests had been done in accordance with both standard practice and equipment manufacturer's recommendations. Water-based fire protection systems are also being inspected, tested, and maintained in accordance with NFPA 25 (Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems). All personnel responsible for the use and operation of the fire protection equipment are trained in the use of that equipment. Refresher training for operating personnel is conducted annually.

The fire suppression color scheme is not consistent throughout the site. (EFI - 2.4.6.04) This class of piping should use white letters on a red background. The color shades recommended are intended to give highest level of recognition to employees with both normal and color-deficient vision. A strong recommendation would be to adopt the ANSI A13.1-1981 Scheme for Identification of Piping Systems. This document addresses employee recognition by offering a common labeling method for use in all facilities.

All fire protection equipment appeared to be in good condition with periodic inspections and testing conducted in accordance with NFPA guidelines and manufacturer's recommendations. Temporary repair clamps (Jiffy) were noted on some of the fire water lines resulting in three priority 3 deficiencies. (EFI - 2.4.6.01 thru 03)

2.4.7 Combustible Gas (LEL) and H₂S Detection: EOF has 21 fixed gas LEL detectors and 25 fixed H₂S detectors. The gas detection sensors were observed to be located so as to provide adequate protection to all operating personnel. They were also observed to be in

proper operating condition. The detection systems are tested monthly by Venoco personnel. One minor deficiency regarding testing documentation was noted. (EFI - 2.4.7.01)

2.4.8 Emergency Shutdown System (ESD): EOF is equipped with both manual and automatic ESD safeguards. Manual ESD stations are located at the North exit gate near the Sulfur Tower and the South exit gate near the helipad as well as inside the control room and are clearly identified in case of an emergency. The ultraviolet / infrared fire eye flame and H₂S detection system also activates the ESD System. The ESD System is tested on 6 month intervals per SIMQAP requirements. Test records are maintained at the facility and this history indicates the system remains in good working order. The condition of this system was deemed acceptable. The design of the process control and ESD system is further addressed in Technical Section 4.3.

2.4.9 Safety and Personal Protective Equipment (PPE): Employees and contractors demonstrated strict adherence to the PPE standards. They were observed to comply with rules and standards on the use of steel-toed safety shoes, hardhats and safety glasses, and were observed to consistently follow other applicable rules and procedures. The use of proper PPE is covered in depth during the orientation process.

Equipment safeguards throughout the facility appeared to be securely in place and in good condition. Generally safety showers and eye wash stations are located within 10 seconds of travel distance from the potential hazard source since the first 15 seconds following chemical exposure is the critical period. In addition safety showers and eye wash stations are to be identified with a high visibility sign. Currently there is only one safety shower located at the Sulfur Loading Rack in the Locat Unit. This shower has temporary repair clamps on the water supply line and is not identified with a sign. (EFI - 2.4.9.04) In addition, the chemical storage area has no safety shower and the eye wash station lacks visibility and is located in an area with no clear path. (EFI - 2.4.9.01 & 02) Additional recommendations include the installation of a water supply inline filter. The filter will keep foreign particles to a minimum and maintain the quality of water at the eyewashes.

A review of personnel safety-training records showed that instruction related to federal and state environmental and occupational safety and health rules and regulations, such as HAZWOPER, HAZCOM, lockout / tagout, emergency response, release reporting and safe use of facility equipment is occurring and being done on an annual basis.

Standards for lockout / tagout were developed to help prevent injury to personnel when servicing and maintaining facility machines and equipment. The unexpected energization or start-up, or release of stored energy can cause injury and / or death. Venoco adheres to these standards and appears to have a good training and refresher training program to ensure operating personnel are proficient in lockout / tagout procedures. OSHA regulation 1910.147 states that employees are to be provided with individually keyed personal safety and/or group locks. Venoco utilizes color coded group locks for operations and the various crafts.

2.4.10 Lighting: The production facility appears to have sufficient lighting to conduct normal operations, and operating personnel indicate that they have experienced no problems relating to lighting. Primary area lighting is provided by pole mounted fixtures with high-pressure sodium vapor or similar type lighting. Area lighting can also be powered by the

auxiliary generator in the event of a power failure. In addition a battery backup system is in place to supply emergency lighting. Area lighting will be addressed further in depth later in the electrical portion of the audit.

2.4.11 Instrumentation, Alarm, and Paging: Pressure and temperature gauges are located throughout all processes on all locations. A few gauges appeared to be weathered, but most were readable and seemed to function properly. The facility instrumentation is tested, maintained, and calibrated on a regular schedule. Records are readily available and the device history can be tracked through the maintenance database program. All “direct read” instrumentation appeared to be properly maintained and in good operating condition. The process systems alarm annunciation panels and the Programmable Logic Controller (PLC) interface is located in the control room. The alarm panel and PLC are used to monitor the process and alert personnel of operating conditions.

2.4.12 Well Safety System: EOF is a land based process facility, which receives produced fluids from Platform Holly and does not have any oil production wells located on site. There is one waste water injection well at the plant.

2.4.13 Auxiliary Generator: EOF has a 400 KW 3-phase A/C auxiliary generator manufactured by the Lima Electric Company and powered by a Detroit Diesel engine. The auxiliary generator system is designed so that the generator automatically starts in the event of a power failure based upon a procedure approved by Santa Barbara County. The unit has a 78 gallon fuel tank providing for 4 hours run time. The auxiliary generator has the capacity to power the air compressor, area lighting, hydrocarbon sump, and the Vapor Recovery Unit (VRU) compressor 1st stage as well as auxiliary equipment for the VRU. The UPS system also provides additional power for computer-based and instrument systems. The system can provide up to 10-hours of emergency power if necessary and is inspected on a monthly basis.

2.4.14 Compressed Air System: EOF utilizes three (3) 25 Horsepower Sullair compressors rated at 100 ACFM each for instrument air supply. An Amloc Energy Saver Air Drying System utilizing double dryers is used with air filters installed upstream and downstream of the dryers. The Amloc System uses a desiccant for moisture removal and automatically switches between the two dryers to allow for desiccant regeneration. Air discharges from the dryers to air receiver V-237 from where it is routed throughout the facility. No discrepancies were noted.

2.4.15 Spill Containment: In general, the spill containment appeared to be adequate throughout the facility. Raised asphalt berms, block walls and the below ground area encompassing the Locat Unit as well as the below ground area east of the oil storage tanks referred to as the Fluor cellar appear to provide the capacity needed for sufficient containment. All hydrocarbons drain to the Hydrocarbon Sump located in the Fluor cellar where they are pumped back into the system via the Heater Treater. All storm water drains flow to the Storm Water Sump also located in the Fluor cellar. All storm water is held and allowed to backup into the Fluor cellar if necessary until test results by an independent third party laboratory confirm that the storm water is in compliance with the parameters of the Regional Water Quality Control Board. All laboratory analyses are required to be conducted by a laboratory certified with the State Department of Health Services. Once these parameters are met, storm water is discharged via a single 4” marine outfall line extending approximately 1500 feet out into the

Pacific Ocean.

2.4.16 Spill Response: The cleanup materials and equipment located at the EOF are stored in the Seatrain storage trailer located on the east perimeter area of the facility. Pollution control equipment is inventoried monthly and consists of spill booms, absorbent pads, shovels, rakes, hand tools, flashlights, tape, etc. Venoco and contract personnel are considered to be the primary responders to minor spills. Outside contract services are used for larger spills and will respond with necessary personnel and equipment resources within an appropriate response time, in the event of a discharge. Spill response procedures are discussed in more detail in the Spill Response Plan in the Administrative Audit.

2.5 Mechanical Integrity / Preventive Maintenance Program

This section gives a general evaluation of the preventative maintenance conducted and addresses the integrity and condition of other machinery and equipment not previously covered by this report. This section also provides comments on specific areas of concern.

Operating personnel conduct preventative maintenance on all critical process and operational equipment. The computer based maintenance program provides an effective tool for managing equipment maintenance and is used extensively by company personnel to enter work orders for malfunctioning equipment. This system provides the ability to schedule, and record preventative maintenance and repairs at Ellwood and Platform Holly. Preventative maintenance (PM) for major pieces of process equipment (i.e. vessels, tanks, piping, and machinery) is scheduled through the maintenance program and based upon manufacturer's recommendations and operating history. Maintenance records for critical process equipment and machinery have been reviewed and overall, the equipment at EOF appears to be in good condition. Only one minor deficiency due to cracked pump pads was noted. (EFI - 2.5.1.01) Preventive Maintenance issues are further addressed in the Administrative Section of this report.

Electrical Audit

3.0 ELECTRICAL AUDIT:

3.1 Goals and Methodology:

The primary goal of the ELC Team was to evaluate the electrical systems and operations at Venoco Ellwood Onshore Facility (EOF) to determine conformance to the California Electric Code (CEC) and industry standards.

References used in review of facilities include documents published by the American Petroleum Institute (API), National Fire Prevention Association (NFPA), the State of California Electric Code (CEC), National Electrical Testing Association (NETA) and State Lands Commission Regulations. The ELC Team review comments are primarily based on API RP 500, API RP 540, and the CEC. The drawings used in support of the audit were Electrical Single-lines and Area Classification Drawings for the Ellwood Facility.

The ELC Matrix, Section 3.0, provides a detailed listing of the locations and items identified for correction. The matrix is organized in sections. Each section is discussed below along with examples of typical items encountered.

3.2 Hazardous Area Electrical Classification:

The API recommended practices and CEC requirements provide specific guidelines for the electrical classification of hazardous areas and installation practices for electrical equipment and materials within classified areas. The ELC Team review comments for all hazardous areas are based on API RP 500, API RP 540 and CEC documents.

The purpose of an Electrical Area Classification Drawing is to define the locations of boundaries and areas where specific electrical installation practices are required to manage the explosive properties of flammable liquids, vapors and other volatile materials. Installation and maintenance of electrical systems requires attention to the type of hazard and the level of the hazard in order to insure compliance with the CEC. Electrical Area Classification Drawings are required to contain the information necessary for a qualified electrician to perform work in and around classified areas.

The addition, relocation or change in process equipment, lines and valves requires that classified areas be reassessed and that classified boundaries be redrawn. If the Area Classification drawings in some cases do not show the present conditions, all new electrical equipment purchased for installation should meet the most stringent requirements and be rated explosion-proof in accordance with the Code.

After updating and revising the area classification boundaries as required by the matrix and as described below, additional equipment may be identified as unsuitable. Electrical equipment that is not suitable for installation in a classified area will need to be relocated, replaced with equipment that is suitable, purged, or non-permeable barriers will need to be installed. Enclosed and gasketed fittings are suitable for Division 2 but not Division 1. NEMA 3R enclosures are suitable for unclassified areas but not Division 1 or Division 2. Where non-explosion proof enclosures with arc producing devices are located in Class I areas they are required to be purged and pressurized per NFPA 496.

In several cases seals installed at area classification boundaries were found without sealing compound poured. (ELC - 3.2.01 & 02)

3.3 Electrical Power Distribution System, Normal Power:

3.3.1 System Configuration: Electric power for normal operations is supplied by Southern California Edison. The Edison 66kV line feeds an SCE 10MVA, 66kV-12.47kV transformer on site that supplies 12.47kV power to the Ellwood main Switchgear. The 12.47kV main switchgear provides power to the Following:

- Gas Compressor K201
- Two (2) 3750 kVA, 12.47kV-4.16kV Transformers to the 5kV Switchgear
- Two (2) 2000 kVA, 12.47kV-480V Transformers to the 480V Switchgear
- One (1) 5000 kVA 12.47kV-16.34kV Auto-transformer supplying Platform Holly

The service location is at the Ellwood 12.47 kV main substation switchgear lineup. The main switchgear protective relays were last tested in May of 2005. Maintenance testing of the switchgear is required. (ELC - 3.3.1.01)

Standby power is provided by one 400kW emergency generator located west of the electrical building. The generator supplies the standby generator Motor Control Center through an Automatic transfer switch (ATS). A 7-kVA UPS system is provided to supply alarms and controls. Standby power systems are discussed in Section 3.5.

3.3.2 Electrical Single-Line: The electrical single-line drawings E-E-720, through E-E-724 used for review of facilities were dated between 2000 and 2004. The drawings are generally representative of the electrical power system; however, changes to the electrical system after the issue date have not been incorporated into the drawings. (ELC - 3.3.2.01 & 02) The audit focused on power distribution systems 480 V and above and excluded the lower voltage systems.

Tagging of switchgear and MCC lineups within the substation and on the single line drawings have duplicated numbers (i.e. MCC-1, MCC-2, Panel C and Panel D are used more than once). This makes following the drawings and the physical layout confusing. Equipment labels and tags should be provided with unique numbers. (ELC - 3.3.2.03 & 04)

3.3.3 Equipment and Component Ratings: The normal power system capacity appears adequate for the present loads based on present load. However, actual system capacity could not be confirmed against actual power usage as meter readings were not obtained. (ELC - 3.3.3.01)

From the single line drawings and a spot check of several MCC starters, over current protection and wire sizes were found to be appropriate. The application of over current devices with respect to equipment ratings is generally satisfactory.

3.3.4 System Electrical Design Safety: The power system installation appears to be maintained for safe operation, in general. Three transformers were noted that need to have openings plugged. (ELC - 3.3.4.01 thru 03) Equipment was not adequately labeled for arc-flash. (ELC - 3.3.4.04) The MCC assemblies include buckets where the vertical bus plugs are missing. The bus plugs are required to be installed to eliminate the exposed bus condition. (ELC - 3.3.4.05)

3.3.5 Grounding (System and Equipment): CEC Article 250 provides the requirements for power system grounding and bonding. The requirements for grounding are established to prevent or reduce the possibility of personnel injury due to shock hazards resulting from elevated touch potential as a result of improper grounding. The rules of grounding also contribute to reduction of equipment damage. Three specific types of grounding are required at the facilities; power system grounding, safety or equipment grounding, and static grounding. Transformers of separately derived systems for 480Y/277V, 240/120V and 208Y/120V are solidly grounded and satisfy Code requirements for power system grounding.

Article 501-16, Bonding in Class I areas, states that all non current carrying metal parts and enclosures associated with electrical components shall be connected together, bonded, and be continuous between the Class I area equipment and the supply system ground. Bonding shall provide reliable grounding continuity from the load back to the power transformer grounding. The best way to achieve this is to include properly sized equipment grounding conductors with each set of power conductors from the source of power to each of the equipment grounding points and include bonding jumpers at points of discontinuity along the route. Equipment grounding conductors are not installed on all circuits and bonding is achieved through continuity of raceways and fittings. Equipment bonding conductors to major equipment; transformers, switchgear and the like, were installed and appeared adequate.

CEC 501-16(b) requires that all liquid tight conduit used in a hazardous area be supplemented with either an internal or external ground bonding jumper. Spot check of the facility found these external grounds have been included on liquid tight conduits.

3.4 Electrical Power Equipment Condition and Functionally:

3.4.1 Wiring Methods and Enclosures: Given the harsh environmental conditions near the seashore, the overall condition of electrical equipment can be rated as good.

Labeling for safe operation is a concern. In addition to the confusing item number duplications noted in 3.3.2 above, individual MCC buckets were not labeled as to circuit identification and load served. Rather, notations were marked on white boards attached to ends of MCC's. (ELC - 3.4.1.01)

In the main substation building, modifications to ARCO MCC-1 and MCC-2, and Stretford MCC-1 and MCC-2 have left open holes in enclosures, missing cover plates on the face of the equipment, missing shutters and exposed wires. Wires need to be safe ended and hinged door openings need to be plugged or closed. (ELC – 3.4.1.02 thru 07)

The working space in front of switchgear, motor control centers and 48VDC panel in the electrical switchgear building was used for equipment storage in several locations. (ELC - 3.4.1.08 & 10) Access to the Cutler-Hammer high voltage ground fault detection system is blocked by stored equipment. (ELC - 3.4.1.09)

3.4.2 Safety Procedures: Safety Standards (procedures) in the operations manual cover the electrical equipment lockout / tag-out / block-out program. The scope, responsibility and procedures outlined in the document appear to be adequate and complete. A Venoco "Equipment Isolation List" form including lockout / tag-out is filled out prior to performing maintenance work.

Planned maintenance is scheduled and controlled through the MP2 program. Maintenance work tasks are input into the MP2 database and identified by task, equipment tags, responsible individual, due date, priority (1 to 4), etc. Reports and work orders are published two weeks prior to the due date and distributed to the responsible party. Tasks are tracked and flagged if they have not been cleared fourteen days after due date. Work orders include a list of the activities required for each task.

The safety standards in the operations manual include a section on arc-flash protection; however, this document needs to be updated to the latest requirements of CEC-2004. The arc-flash labels found on switchgear and MCC's are not in compliance with the latest standards as required by CEC 110.16. The safety standards manual needs to be updated and arc-flash labels applied to electrical equipment. (ELC – 3.4.2.01, 02 & 04) A revised arc-flash hazard assessment study is required to establish and update incident energies and hazard categories.

The Electrical Safety, Operating and Training Procedures Plan (ESOTPP) was missing pages at the time of the investigation and could not be fully evaluated. (ELC - 3.4.2.03)

Personnel were unaware of the existence of any extension cord and portable equipment testing programs. CEC 305 identifies a maximum time constraint of 90 days for temporary installations. No methodology was found in the Venoco literature to test, track or verify that temporary and portable extension cords meet CEC 305. It is recommended that Venoco set up a testing schedule (quarterly, every 90 days) and marking system for temporary power extension cords and a method to identify when cords were last inspected for safety. (ELC - 3.4.2.05)

3.5 Emergency and Standby Power:

3.5.1. System Configuration: Ellwood operations standby power is provided by a 400-kW, 480-volt, 3-phase diesel driven generator located west of the electrical building switchgear room and connected via 600-amp auto-transfer-switch to the "standby generator MCC". The standby generator starts automatically during a total power failure or power dip to provide power to maintain the facility vapor recovery and instrument air compressors.

Items supplied from the standby generator MCC also include: Hydrocarbon sump pump, cooling water fans and pumps, building pressurizing fans, instrument air compressor, vapor recovery units VR-1 and VR-2, and 480-208Y/120V transformers in the ARCO MCCs

supplying panels MCC1-C, MCC1-D, MCC2-C, MCC2-D and the transformer feeding distribution panel "A" in the switchgear room. Panel "A" in turn supplies power to the UPS.

Backup generator loads and generator fuel consumption / run time could not be determined. (ELC - 3.5.1.01 & 02) Preparation of a single line diagram of all emergency loads to aid in determining generator run time for a full tank of fuel is recommended.

UPS power is provided from a 7-kVA Z-Best Ferrups UPS unit located in the office next to the switchgear room. The UPS supplies power for the equipment PLC's, the H2S and Gas detection equipment, telecom and communications systems.

3.5.2 Equipment and Component Ratings: MRMD regulation 2132(g)(7) requires "an auxiliary electrical power supply shall be installed to provide sufficient emergency power for all the equipment required to maintain safety of operation in the event the primary electric power fails".

The 400kW standby generator and standby MCC power system appears adequate to the present load conditions as indicated on drawing E-E-720-3. The 7-kVA UPS unit appears adequate to supply the current alarm, control and communications systems.

3.5.3 Electrical System Design Safety: The original internal wiring to the 480-208Y/120V transformers feeding panels physically located in the ARCO motor control centers MCC-1 and MCC-2 has been field modified. The internal connections are removed and new external feeders supplied from the standby generator MCC. Warning labels should be added to the panels indicating the existence of multiple supply sources of power to the affected ARCO MCC cubicles and the external power source location indicated on the label. (ELC - 3.5.3.01)

3.6 Electric Fire Pump System:

One 200 hp electric fire pump is located adjacent to the diesel fire pump near the north-east corner of the facility. Both are controlled through the firewater controller panel located nearby. The diesel fire pump acts as primary with the electrical fire pump as backup. The electric fire pump is fed from ARCO MCC-1. No operational description of the fire water pump system was received. Provide system operational description and diesel run-time for full tank of fuel. (ELC - 3.6.01 & 02)

3.7 Process Instrumentation Wiring Methods, Materials and Installation:

The process control system uses a combination of pneumatic, hydraulic and electrical instruments and controls. The process control system includes the use of computers, programmable logic controllers (PLC's) and relay logic to control and interface with valves, solenoids and pump controllers. Alarms are produced by level, temperature, pressure and flow sensors advising operators of process conditions.

Process monitoring and control is provided via personal computers (PC's) and PLC's linked over a modbus + network and function through the Wonderware software package. Platform Holly PC's are interconnected over an Ethernet Data Highway and Microwave data link. The Ellwood facility monitors process status only at Platform Holly and has no control capability for platform operations. Drawing E-E-2006-101 shows the network interconnection. All alarms are captured and logged by the Wonderware system.

PC's in the control room monitor and control the PLC's. A redundant Wonderware development PC in the Supervisor's office next to the switchgear room is used for programming changes to the system. Major programming changes are backed up to the main offsite server located at Venoco offices in Carpinteria, CA.

Process alarms are displayed on the main control panel in the operator control room. Fire and gas alarms are segregated by zone on the panel.

- Zone 1 – Compressor Area
- Zone 2 – York and Fire Pump Area
- Zone 3 – Fluor Area
- Zone 4 – LPG, Oil Tanks and VRUs
- Zone 5 – LPG Rack and Barrel Dock
- Zone 6 – Pig Catchers / Exchangers
- Zone 7 – LOCAT Unit Area

Emergency and shutdown systems are operated through relay logic and are not run off a PLC. The ESD relays are located in the shutdown panel assembly adjacent to the annunciator panel on the east wall of the operations control room. See section 3.9.1 for further description.

3.8 Standby Lighting:

Area lighting is provided by pole mounted and building mounted floodlights. The lighting is fed from panels connected to the standby generator.

Fixtures are installed in conformance with the CEC and appear to be located to provide adequate lighting levels for the tasks performed. Fixtures are appropriate types and designs for the environmental and hazardous area conditions. Consideration should be given to conducting an outdoor lighting survey to determine if modifications are required to comply with Title 24 outdoor lighting requirements.

3.9 Special Systems:

The ELC Team review comments for special systems are based on API RP 500, API RP 540 and CEC documents.

3.9.1 Safety Control Systems: Safety control systems are required to be a combination of devices arranged to safely affect plant shutdown. Electrical safety control systems are normally operated energized and fail-safe. Failure of external power to a safety control circuit requires an audible or visual alarm to be initiated or operation of equipment in a fail-safe condition.

Emergency Shutdown: Four Emergency Shutdown Stations, (ESD's) are located throughout the facility. The stations appeared to be in good working order. The stations include: ESD-1 at the main entrance gate; ESD-2 at the main exit gate; ESD-3 at the gate leading to the heliport; and ESD-4 on the Main Control Panel in the Operations Control Room. Stations are hard wired to the shutdown panel assembly located adjacent to the annunciator panel on the east wall of the control room. Relays in the panel initiate automatic shutdown of equipment by the following:

- Deactivates solenoid valves on the pneumatic system thus closing the inlet gas and oil lines from Platform Holly and the outgoing sales gas line affectively shutting in the facility.
- Trips circuit breakers in the 15kV SWGR that supply compressor K-201, K-205, K-206, associated pumps, transformers #2 & #4 feeding the 4160 volt system, and the capacitor bank.
- Activates the EMERGENCY SHUTDOWN annunciator alarm.

The ESD system is tested semi-annually and documented. ESD stations and other ESD actuating devices are tested monthly, quarterly and semi-annually and records are maintained.

Plant Shutdown: Plant shutdown can be initiated by any one of eight alarms. These include the four ESD switches mentioned above, H₂S, LEL & Fire Detection shutdown circuits and process high levels alarms on the heater treater units and wet oil tank. Like an emergency shutdown, a plant shutdown effectively shuts in the EOF and in addition lights up the PLANT SHUTDOWN annunciator alarm and sends an alarm signal to Platform Holly.

In addition to the Plant ESD system, the EOF has equipment / process specific shutdown systems that allow for the emergency or non-emergency shutdown of certain equipment without triggering the complete shutdown of the facility. Specific ESD systems are located in the LOCAT unit, York Unit, and the Gas Chromatograph on the sales line. Local ESD buttons on each unit will shut down and seal-in respective units. After the ESD has cleared, the specific item can be reset in the field by an operator.

3.9.2 Gas Detection Systems: Combustible gas detection systems, LEL, and H₂S are employed at EOF to detect combustible gas leaks in equipment and piping, to warn personnel of explosive and toxic concentrations and to initiate remedial action. Twenty-five H₂S sensors and twenty-one LEL sensors are located about the facility. Signals from the gas detectors are hard wired to the Gas Detection Module in the control room panel. Gas detection alarms on the main control board annunciator are segregated by plant zone. Gas monitors are tested monthly and records are maintained.

3.9.3 Fire Detection: Fire detection and smoke detection is usually employed to detect and warn personnel of fire and smoke conditions and to initiate remedial action. Fire-Eye sensors are located at 43 locations throughout the facility. General Monitor Model FL3000 (IR/UV) and Model FL3001 (UV) flame detectors protect the various zones within the facility. Signals are returned to the Fire Detection Module in the control room panel. Fire detection alarms on the main control board annunciator are segregated by plant zone. Fire detectors are tested monthly and records maintained.

3.9.4 Aids to Navigation: Not applicable to on-shore installation.

3.9.5 Communication: Communications systems are established to provide for normal and emergency operations. Systems used for emergency communication should have battery-operated supplies good for at least four hours of continuous operation as required by API RP 14F. The 7kVA UPS unit supplies power for communications. The operator shall confirm that the UPS has the capacity to supply power for communications for at least four hours.

Communications with Platform Holly is provided via microwave link. Intercom communications are provided by phones located within the facility.

3.9.6 General Alarms: General Alarms shall be audible in all parts of the facility to notify personnel to respond to an emergency. Red lights can be used in conjunction with the audible alarms. All General Alarm sounding devices shall be identified by a sign at each device in red letters at least one inch high describing required personnel response.

Signals from the fire, gas detection and H₂S relays activate the Gaitronics panel siren and the front gate beacon. The Gaitronics panel oscillator provides the various required signals:

- Yelp – LEL
- Warble – H₂S
- Siren – Fire
- Pulse – Process

3.9.7 Cathodic Protection: The impressed current cathodic protection system consists of five cathodic protection rectifiers. Rectifiers #1 and #2 are located in the south corner of Zone 3 – Fluor area, Rectifiers #3 and #4 on the north side of Zone 8 – LOCAT area, and Rectifier #5 located behind the switchgear building near the backup generator. Units appear to be in good working order.

Technical Audit

4.0 TECHNICAL AUDIT:

4.1 Goals and Methodology:

The goal of the Technical (TEC) Team was to evaluate the design of the production facilities for compliance with current regulations, codes, and industry. The design review focused on the production process safety systems and other key equipment including the emergency shut down system, the pressure relief, vent, and flare systems, combustible and hazardous gas detection systems, fire detection and suppression systems, spill prevention, spill response systems, and any apparent facility design issues. The TEC Team addressed design concerns previously identified by the EFI or Electrical Teams.

The TEC Team used the previously verified P&ID's, the operations manuals, which contained information on equipment controls and safety devices, as well as any existing Cause and Effect charts and Process Hazard Analyses (PHAs) for the facility. The review of the process safety devices at the facility followed methods recommended by the American Petroleum Institute (API) and accepted industry practices. API publishes these Recommended Practices for Analysis, Design, and Installation for Onshore Production facilities.

Review of the onshore processing facility design and safety system was conducted by reviewing existing PHAs, which are a key requirement within process safety management (PSM) regulations or standards. At Venoco Inc., production quantities were reported as being above the threshold where Cal OSHA requires PSM; therefore, the review of production safety shutdown equipment was conducted using recently re-validated PHAs. Existing functional relationship charts from the original design, construction and operation of the facility, and charts developed for select equipment by the technical team to evaluate safeguards against common industry practice were also key information used. The functional relationship charts (Cause and Effect Charts) and their evaluation by the technical team are similar to the safety analysis function evaluation (SAFE) chart and methods used in API RP 14C for offshore platforms that match equipment or system risks with safeguards provided by specific safety devices. Other general industry criteria, codes, and guidelines considered during the TEC audit were:

- Occupational Safety and Health Administration (OSHA) Standards
- Human Factors
- Risk Management
- Recognized and generally accepted good engineering practices
- ASME, ANSI, NBIC and NFPA (NEC)

Action items were identified where there was significant noncompliance with applicable design requirements. Some recommendations are based on standards that are not a regulatory requirement and are therefore presented only within the text of this chapter as a recommendation or consideration and do not show up as action items.

The technical team's work concluded with evaluations of the fire detection and suppression systems, combustible and hazardous gas detection systems, auxiliary electrical

power, shipping pumps, compressors and pipeline systems, pressure relief systems, and spill containment. Each is addressed on a system basis for the Ellwood Onshore Facility.

4.2 Offshore Production Safety Systems:

Venoco's EOF is an onshore facility that processes the oil and gas; from State Offshore leases PRC 3120 and PRC 3242, from offshore platform Holly and the gas from the two Seep Tents. State lease PRC 421 is currently idle but can also be set up to send production to EOF. Platform Holly was the subject of a Safety Audit covering Offshore Production Safety Systems that was final in April of 2007.

4.3 Onshore Production Safety Systems and Process Hazards Analyses:

Existing re-validated PHAs for these facilities were reviewed in conjunction with the Cause and Effect Chart developed to help evaluate the adequacy of design for safe operations. The Cause and Effect charts list all the process components and Emergency Support Systems (ESS) and corresponding safety devices that are normally available in offshore service. This is considered a very comprehensive and strict standard from which appropriate adjustment can be afforded to onshore facilities because of certain reduced risks compared to an offshore platform. The Cause and Effect chart analysis uses a very stringent philosophy that stipulates two methods of protection or devices, independent of, and in addition to the control devices used in normal process operation. It also seeks to eliminate designs that depend on a "cascading effect" in order to bring the process to a safe condition. Such cascading designs are avoided in offshore service because stressing of components with abnormal process conditions can reduce reliability and stimulate unexpected failures. Dependence on a single safety device in such a design makes the reliability of this device more critical. A single independent device does not provide the comprehensive and redundant protection afforded when there are primary and secondary devices whose operating methods are complementary. Any significant concerns resulting from this analysis of the process safety systems are addressed later in this section.

The safety control systems at EOF are an evolution of the originally installed safety controls. The process equipment was found to have all the required safety devices and compared favorably with the standard (API RP 14C) used for platform Holly's Safety Control System. Associated components were installed using codes and guidelines existing at that time, however new standards have emerged in regards to safety systems; the new standards (ANSI/ISA-84.00.01) address the need for determining the Safety Integrity Level (SIL) of the safety instrumented systems. The standard also recognizes the limitations of general-purpose PLC systems and make a distinction between safety PLC's and their level of diagnostics, implementation of redundancy, and independent certifications verses a standard off the shelf PLC when used in critical applications. In order to determine the appropriate SIL and future system requirements, it is recommended that a Safety Integrity Level Analysis following the ISA/ANSI standard be done during the next scheduled HAZOP or as a separate report referenced by the HAZOP.

Onshore safety systems also include both detection and protection equipment that make up the Emergency Support System. The detection systems include devices for flame, heat, smoke, hydrocarbon and toxic gas. These sensors, in turn, will activate alarms, audible,

visual or both, and/or logic controlling these outputs may activate fire suppression systems and emergency shutdown devices. The various systems are linked together both in a dedicated alarm system and as part of a larger distributed digital control system. The integrity of these safety systems depends upon proper operation of support systems (pneumatic and electrical), in conjunction with routine testing and maintenance of the safety devices.

The Ellwood Facility has a recent history of safe, reliable, and efficient operation over the past six years. Aiding this is Human Factors improvement features that help the operators monitor the integrated safety systems. Operators at the EOF are quickly made aware of potential emergency situations by hazard detection, alarm, and production safety system information. These systems warn personnel of possible fire, gas releases and other events. In addition, the detection, alarm and communications systems are continuously powered by an uninterruptible power supply and an auxiliary generator to allow essential personnel to communicate with others in emergency situations. Alarms, both visual and audio, are installed to alert personnel in other areas of the facility to potential emergencies.

4.3 Wellheads, Surface/Subsurface Safety Valves:

Since the EOF is a processing facility only, there are no production wellheads or Surface/Subsurface Safety Valves present.

4.4 Safety Devices on Vessels and Tanks:

Design considerations of safety systems for pressure vessels and tanks focus on preventing releases, stopping the flow of hydrocarbons to a leak if one occurs, and minimizing the effects of such releases. Industry recommended protective devices can reliably detect abnormal operating pressures, liquid levels, flow direction and initiate shut down action to protect the process component that poses a threat to safety. These protective devices consist of Pressure Safety High and Low (PSH, PSL, or PSHL), Level Safety High and Low (LSH, LSL), and Flow Safety Valves (FSV). This section does not address the required pressure safety relief valves required on tanks and pressure vessels which are addressed in Sections 4.6 and 4.7. Tank and Vessel PSV devices are a self actuating last line of defense.

Safety systems for pressure vessels and tanks are intended to provide automatic monitoring and automatic protection action if an abnormal process condition or event occurs. These devices will activate computer and/or local alarms and should conform to ANSI recommended practices, MRMD regulations and previous ANSI/ISA (1984) standards. Containment and operator intervention augment these systems and the mandatory pressure relief valves covered in the next sections provide a final safety feature. Venoco has recently upgraded the safety systems on several vessels located in the York Skid to connect them to the PLC so that they may be safely monitored from the control room.

Many of the atmospheric vessels within the facility are used for processing and temporary storage of water and liquid hydrocarbons. These process tanks are equipped with LSH and LSL devices as well as pressure-vacuum relief valves addressed in Sections 4.6 and 4.7. Overflow and leak protection is provided by the LSH and LSL sensors. The high and low level sensors start or shut-off transfer pumps to prevent overflow and detect potential leaks. The high and low-level alarms are commonly found on oil storage tanks throughout this

industry. Additionally, the level safety high and low-level alarms are displayed on the process control and alarm computer screens. These level safety devices are tested monthly and the test results recorded and stored on site.

All stock tanks (Storage Tanks) are equipped with LSH devices, vapor recovery systems, and the final safety feature being the pressure-vacuum relief valves. LSLs are used to shut-off the LACT charge pumps to prevent gas blow-by. Additionally, the level safety high shutdowns and low-level alarms are installed and displayed on the control and alarm computer screens. The LSH and LSL safety devices are tested monthly and the test results recorded within the facility maintenance program. The concrete wall surrounding the stock tanks provides adequate secondary containment. Low-level pump shutdown is preferable to a low-level sensor when the normal flow of liquids prevents the sensor's ability to detect a leak. In addition, spill control for these tanks is dependent on flow from one tank to another via interconnecting piping. The interconnecting overflow piping diverts excess oil to a secondary stock tank and reduces the chance of a spill potentially caused by overfilling. This method of spill prevention satisfies the intent of the Oil Pollution Prevention and Response regulation, 40CFR112.9 and no other action items were noted.

4.5 Pressure Safety (Relief) Valves (PSV):

Properly designed, installed and maintained pressure-relieving devices are essential to the safety of personnel and the protection of equipment. Inspection and record keeping were evaluated and addressed as adequate in Section 2.4.4. A Pressure Safety Valve (PSV) study conducted by Venoco in June 2002 was used in evaluating the adequacy of the pressure relieving system under blocked flow and fire conditions. As with other older installations, the PSV or relief valves and associated piping were sized for a much higher production rate than present. Existing valves and system design were found to meet or exceed the required capacity and criteria in API RP 520.

4.6 Relief and Flare System:

Overpressure from various sources throughout the plant is directed to the relief system. In the event of high pressure deviations, pressure safety valves will open and send gas to the relief system. Once in the relief system, the gas is sent through the relief vent scrubber and then sent to be combusted in the Hirt Burners H-205 and H-206. If the pressure in the relief system continues to rise, the relief gas is then automatically also directed to the open flare H-207.

The analysis of the system on file with Venoco included the sizing of PSVs and the safe disposal of relieved gas and liquid hydrocarbons through the Hirt burners or the open flare. The location of the vent scrubber was considered adequate and posed minimal risk to personnel. The vent system has been studied to verify that backpressure imposed by the pressure relieving devices at full header load and there were no unacceptable backpressures on devices releasing into the vent system throughout the facility. The analysis of the relief system also concluded that the system was designed with sufficient capacity, properly anchored, and adequately supported.

4.7 Fire Detection System:

The fire detection system consists of strategically placed flame, H₂S and smoke detection sensors which are tied-in to control room monitors or displays. Depending on their function, these detectors may initiate an alarm only, activate automatic fire extinguishing systems, and may also shutdown process equipment. The original process plant risk assessment determined the number and location of the sensors. Sensor layout was approved Santa Barbara Building and Safety. Below is a list of devices installed at the facility.

- Manual Stations
- Fire Alarms
- Smoke Detectors
- Optical Flame Detectors
- Flammable Vapor Detectors
- H₂S Detectors
- Horns and Visual Alarms

The Ellwood facility is manned 24 hours a day and safety observation checks are done several times a shift to ensure equipment integrity. Primary fire detection for the Ellwood facility is by automatic fire detection systems that use flame detectors. The flame detectors have the ability to shutdown the facility at predetermined UV levels as do the combustible gas and H₂S detectors. The flame detectors are also connected to a fire alarm system that alerts personnel of an emergency through computerized visual displays and audible devices throughout the plant area. Operating personnel are trained to respond as necessary by evacuating or approaching the alarm area using written procedures.

The fire detection system equipment is maintained in accordance with the manufacture's instructions. The test frequency of the sensors is based on NFPA 72 guidelines and a permanent record of all inspections, testing and maintenance is retained by the operator.

4.8 Fire Suppression System:

The function of the fire suppression system is intended to reduce the effect of a fire on the production facility. This is done by limiting the spread of the fire with fire barriers, cooling the equipment and structures, reducing the oxygen supply, and shutting off the fuel supply. The fire suppression systems used within the Ellwood facility consist of a fire water system, a foam system, and dry chemical fire extinguishers.

Fire Water System: The fire water fighting system consists of a pre-pressurized loop system supplying water to hose reels, hydrants, and supplies the deluge sprinklers as well as the foam system. Fire water pumps (2) feed the main loop with municipal water from two elevated 3,000 bbl water tanks. The primary pump is electric motor driven while the secondary pump is diesel driven. Both pumps are rated at 1000 gpm at 185 psi. The electric pump is automatically started by the fire detection devices or whenever the loop pressure falls, typically due to activation by the deluge system, a foam station, or whenever a fire hose is used. The diesel driven pump will automatically start if the primary electric fire pump is unable to maintain the required pressure in the fire water loop. The diesel driven pump has sufficient fuel to operate until additional fire fighting resources can arrive from the County fire station less than 6

minutes away. A test of the firewater system hydraulics, by a private fire protection engineer (Fulton Fire Engineering), showed that both the primary electric and the back up diesel fire pumps had the capacity to supply the deluge system, foam stations, and hose streams with adequate flow and pressure. Weekly test results are recorded and retained for comparison purposes as required by NFPA 25, 5-4. Fire pumps, drivers, and controllers appear to meet the NFPA and UL requirements that were in effect at their time of installation.

Laterals from the main loop connect to zone-controlled deluge sprinklers manually operated by a valve near the foam tank. These sprinklers protect piping and two 40,000 gallon LPG/NGL bullet tanks. Cooling the process storage tanks with the sprinkler system reduces the possibility that this equipment will become endangered before a nearby fire can be extinguished.

Facility fire hydrants and fixed water spray (or deluge) systems appear adequate in design and number. The flow requirements were determined by the insurance rating association which established a protection/class for the facility during construction. The fire hydrant system was also approved by the local fire department and was subject to acceptance tests as required by the chief. The hydrants are flow tested annually to ensure proper functioning and the test results are locally available.

Foam System: The foam system consists of a 1200 gallon "protein" foam tank (V-225). The foam tank supplies a 6-inch buried steel supply pipe around major process areas, which also supplies nine foam-water monitors. Water for the foam tank is supplied through a 4-inch fire water connection. The foam system also supplies fixed foam devices for three crude oil tanks (T-202, T-203 and T-204). The foam devices at each tank consist of a subsurface injector and an over-the-top foam chamber. Foam to each tank is manually controlled by a separate branch from the foam tank. Existing foam concentrate is 3% and is tested annually for contamination and dilution.

Portable Extinguishers: Numerous potassium bicarbonate wheeled 150-pound and 30-pound extinguishers are strategically placed throughout the facilities for incipient extinguishing of small fires in their initial stages. All are inspected on a monthly basis. Company personnel have the option of extinguishing a small fire but rely on the Santa Barbara County Fire Department for their primary fire suppression. A fire station is located approximately 2 miles from the Ellwood facility.

4.10 Combustible Gas Detection and Alarm System:

EOF is equipped with twenty (21) fixed gas Lower Explosive Limit (LEL) detectors that have alarm and facility shut-down capability and this was found to meet the MRMD regulations. The system alerts personnel to the presence of low-level concentrations (25% lower explosive limit, LEL) of flammable gas / vapor by both an audible and visual alarm. As the concentration of the gas approaches 50% of the LEL, shut down of the facility occurs and the firewater pump is started. These limits are found to be in compliance with applicable regulations and recommended standards, MRMD 2132 (g) (5) (C, D). The gas detection system has a history of reliable performance documented by the monthly inspection results, completed in accordance with MRMD regulation 2132(g)(5)(F), maintenance is also well documented.

4.11 H₂S Detection and Alarm System:

EOF has 25 sensors as part of the H₂S detection system that alerts personnel to the presence of hydrogen sulfide gas in the atmosphere at concentrations of 10 PPM by both an audible and visual alarm. As the concentration of the H₂S approaches 20 PPM, they automatically activate the facility shut-in sequences. These limits are found to be in compliance with applicable regulations and recommended standards, as well as MRMD 2132(g) (6) (A) (1). The EOF H₂S detection system is equivalent to that required by MRMD regulations for an offshore facility. The system design and number of gas detection sensors is deemed adequate and their maintenance is well documented. The gas detection instruments are tested monthly, in accordance with MRMD regulation 2132(g) (5) (F).

The H₂S system has been installed to satisfy MRMD regulations, local code requirements, and industry practices. The automated toxic gas system is warranted because of the close proximity to residential, commercial and public recreation areas. In addition, standard industry practice is to install H₂S detection system at onshore facilities where concentrations of H₂S gas may result in a release where the atmospheric concentration may reach 50 PPM to 100 PPM.

Gas dispersion modeling for the EOF was conducted by Venoco and indicates that a combustible and toxic H₂S gas release from the facility will not pose significant exposure risk to the public and that additional safeguards beyond the installed systems are not necessary.

4.12 Auxiliary Electrical Power Supply:

The EOF is equipped with an auxiliary generator and there is an uninterruptible power supply (UPS) for the PLC system. The auxiliary generator is a 400kW diesel driven generator that starts automatically in the event of a power outage. The generator is designed to supply power through an automatic transfer switch (ATS) to the gas and fire detection systems, alarm sensors, PLCs, emergency lighting, and the vapor recovery system. There is enough generator fuel capacity to supply backup power for approximately eight hours before refueling. During an initial power failure the PLC will automatically switch to the uninterruptible power supply (UPS) before transferring to auxiliary power. In the event of a power transfer failure, the UPS system has the ability to provide power to the computer systems for approximately two hours to allow the safe shutdown of the facility

4.13 Compressors, Shipping Pumps and Pipelines:

The offshore pipelines from Platform Holly to shore were covered in the April 2007 Holly Safety Audit Report. Therefore we only reviewed the shipping pipelines from where they enter the EOF and also include the pigging procedures. The oil and gas pipelines from Holly to EOF are routinely smart pigged and are in compliance with API RP 570, MRMD requirements and accepted industry practices including a HAZOP review.

Onshore pipelines are to be designed, constructed, tested, operated and maintained in accordance with the regulations of other agencies. The safety audit evaluated the use of appropriate safety devices and adherence to accepted industry practice. Accepted industry

practices and recent requirements for “best achievable protection” point to re-evaluation of leak detection and other safety systems to minimize spill volume in the event of a leak. Safety devices (PSHLs) on oil and gas pipelines sense abnormal operating conditions or equipment condition and react by shutting down entire systems. Measures taken by Venoco Inc. to reduce the risk of oil leaks in this area include: cathodic protection, hydrostatic testing, and pipeline maintenance pigging. The onshore oil pipeline is hydrostatically tested yearly and cathodic protection readings are done monthly.

The shipping facilities are comprised of oil shipping pumps and shipping pipelines. Each of the shipping pumps is equipped with a FSV to prevent backflow and a PSH as a primary defense against over pressurization and a PSV for secondary protection. In addition, the shipping pipelines are protected from over pressure by PSVs. This shipping pump safety system appears to be adequate and additional safeguards are not necessary.

4.14 Spill Containment:

The tech team evaluated the secondary containment volumes available at the EOF and found them to be adequate for meeting the spill control and containment (SPCC) regulations. The storage tank containment volume is adequately provided by the Fluor cellar and the containment area for the Lo-Cat tanks is also adequately sized. The containment volumes provided will contain more than the volume of the largest tank plus the recommended allowance for precipitation while excluding the volumes occupied by other tanks.

The integrity of all berms and containment walls were addressed previously in the EFI section and found to be adequate. There were no other spill containment design issues to be addressed.

Administrative Audit

5.0 ADMINISTRATIVE AUDIT

5.1 Goals and Methodology

The goal of the administrative audit (ADM) team was to verify the availability of and review the manuals, programs, procedures, and records required by Federal, State and local authorities as well as adherence to applicable industry standards. The primary function of the ADM team is to evaluate the Operations Manual and Marine Facility Oil Spill Response Plan for the Ellwood Onshore Facility (EOF). A secondary effort was placed on the evaluation of other required PSM elements and associated plans, manuals, policies, and documents that are needed for safe facility operations. The facility Operating Procedures Manual and Oil Spill Contingency Plan were evaluated at the CSLC office in Long Beach while all other manuals and records were reviewed at Venoco's Ellwood Onshore Facility (EOF) offices.

5.2 Operations Manual

The Ellwood Operating Procedure Manual was reviewed for structure and content using MRMD and PSM regulations as guidelines. The manual was arranged in a logical manner and included a table of contents, numbered pages and reference tabs for quick and easy access. An in-depth review of the manual found that there were deficiencies in regards to MRMD content requirements. These omissions resulted in ten Priority 3 action items being generated.

The primary copy of the Operations Procedures is located in the facility control room in a location that is easily accessible to all personnel. A detailed review of the Ellwood Operations Procedures was conducted using PSM standards and MRMD regulation 2175. The Operating Procedures Manual was arranged in a logical manner with a table of contents, numbered pages, and reference tabs for quick and easy access.

MRMD requirements include specific information as to the equipment located within each facility, safe operating practices for the equipment, facility startup and shutdown procedures, and emergency procedures. However, in-depth review of these required elements determined that the content of the manual was not entirely in compliance and resulted in ten Priority 3 action items being generated.

The manual provides sufficient information regarding the Systems Safety and Automatic Control Systems and equipment and satisfies the requirements within MRMD Regulation 2175(b)(7) and (8). The Systems Safety includes adequate information pertaining to training, equipment and procedures. The Automatic Control Systems and Equipment section provided enough information concerning the identification, use, and operation of any safety equipment that can be operated remotely, automatically, or by pre-program and appropriate manual overrides. This information is provided in the Operation Procedures for these systems and for each major piece of process equipment. The Operations Procedures includes material balance information for each production flow stream, including operating pressures, quantities, temperatures, properties, capacities and physical size, pressure and temperature ratings for all equipment in written form. However, this information was not included in the Operating Procedures resulting in a priority 3 action item. (ADM – 5.2.10) A reference to the facility Operating Procedures and API RP 14C "SAFE" chart could serve as a practical method of providing more in-depth coverage.

The review by the Administrative Audit team revealed that the Operations Procedures lacks certain required information. The manual did not include maps and charts as required by MRMD Regulation 2175(b)(1). (ADM - 5.2.01) This section should clearly indicate the location of the facility and its relationship to nearby geographic features.

Ownership and responsibility information was also missing from the manual as required by MRMD Regulation 2175(b)(2). (ADM - 5.25.02) This information identifies the owner or owners of the facility and any others that may be responsible for the operation of the facility and the implantation of contingency plans.

The Operations Procedures does not contain a listing of staff positions showing the chain of command and the responsibility of each position as required by MRMD Regulation 2175(b)(4). (ADM – 5.2.03) Employee qualifications for their respective positions must be outlined within this section and staffing levels for the facility justified.

Plot plans and flow diagrams for each of the facility production flow streams as well as pertinent data for each major component was not part of the Operating Procedures. In addition detailed information regarding preventive maintenance and procedures was not provided as required by MRMD Regulation 2175(5)(A) & (B). (ADM – 5.2.04) A description of how maintenance records are generated and maintained as part of the Preventive Maintenance program should be described within this section.

Personnel safety information regarding equipment and procedures, which includes training, drills, inspection of safety equipment and safety responsibilities for each position as required by MRMD Regulation 2175(6) was not part of the Operations Procedures. (ADM – 5.2.05) This information is necessary to ensure personnel safety.

Also of concern, the Operating Procedures, did not provide any information concerning the fire fighting response specifically information regarding the primary and secondary response and any other emergency response plans that may be in effect as required by MRMD Regulation 2175(11)(A), (B) & (12). (ADM – 5.2.06, 07 & 08) The information should give detailed descriptions of response equipment and their use along with descriptions of communications equipment, evacuation plans, mutual aid, interagency agreements or memoranda of understanding.

In addition, owners or operators of facilities with Program Level 3 processes are required to certify annually that the operating procedures are current and accurate. The EPA also requires that the employer must certify annually that operating procedures are current and accurate for PSM facilities. (ADM – 5.2.09)

Venoco's management of change (MOC) policy requires that any changes to the process or equipment should be updated in the manuals that may be affected by these changes and that manual recipients are provided with replacement pages on an annual basis.

5.3 Spill Response Plan:

The Ellwood facility has an extensive Oil Spill Contingency Plan (OSCP) that fulfills the requirements for an Oil Spill Contingency Plan contained in the California Department of Fish and Game, Office of Spill Prevention and Response (OSPR) regulations, CCR Title 14, Section 817. The plan is also coordinated with the Federal Spill Prevention, Control, and Countermeasures (SPCC) Plan requirements that are contained in the EPA regulations, Title 40, CFR, 112.5. The SPCC is addressed in section 5.4.

The OSCP is a written document that includes a copy of the California Certificate of Financial Responsibility (COFR) and provides for an incident command system, provides procedures for reporting oil spills, describes communication plans, describes protection strategies, identifies an oil spill responder (OSRO), identifies a qualified individual (QI) and identifies an agent for service of process as required by Office of Spill Prevention and Response regulations.

Venoco's South Ellwood Field OSCP includes the Ellwood facility as well as five other Venoco properties. As outlined in both the introduction and scope of the plan Venoco's OSCP was prepared to meet the requirements of United States Coast Guard, Environmental Protection Agency (EPA), Department of Transportation (DOT), OSPR (State of CA) and Santa Barbara County. Venoco's OSCP, completed with assistance from Goldberg Environmental Services, Santa Barbara, looks very professional and appeared complete.

The OSCP was reviewed and found to contain the following required general content:

- Facility description
- Hazards Evaluation Study and potential worst case spill scenario evaluation
- On-water containment and recovery procedures
- Shoreline protection and clean-up
- Spill Response and Notification procedures

The OSCP was thoroughly examined to also verify detailed content requirements using CSLC checklists developed from the regulations. Sections 1.0 thru 2.6 and appendix A thru U of the OSCP were found to adequately address the policies and procedures to prevent, evaluate, contain, mitigate, and review the effects of unauthorized discharges. The oil spill response training information and spill drill schedules were found to be up to date or adequately addressed. The specific procedures outlined within the manual included:

- On-water Containment and Recovery of Oil Spills
- Notification, Spill Response and Cleanup
- Shoreline Protection and Cleanup
- Waste Management Procedures
- Wildlife Care and Rehabilitation Procedures
- Hazardous Materials Communications and Training Program

The OSCP meets CSLC Regulations with only minor items to be addressed, resulting in five priority 3 action items. These discrepancies included: expired certificates of financial

responsibility (COFR). (ADM – 5.3.01) Facility name not specified within COFR 20799-00002. (ADM – 5.3.02) The OSCP does not include a COFR for Beachfront Lease (PRC 421). (ADM – 5.3.03) The OSCP is not certified by an executive with the plan holder's management for authority to implement the plan. (ADM – 5.3.04) The OSCP is not certified by the plan holder's management for accuracy, feasibility, and executeability. (ADM – 5.3.05)

5.4 Required Documents and Records

Regulatory agency required documents are available at the EOF. These documents include the aforementioned Ellwood Operating Procedures Manual and the Oil Spill Contingency Plan, South Elwood Field as well as Spill Prevention, Control and Countermeasure (SPCC) Plan, Storm Water Pollution Prevention Plan (SWPPP) and Monitoring and Reporting Plan (MRP), Area Contingency Plan (ACP), South Ellwood Field Safety Plan, and Illness & Injury Prevention Plan (IILP). In addition, as a PSM facility the EOF is required to periodically update their PHA programs. This frequency of process risk management assessment should be done every 3 to 5 years based on incidents or accidents, process changes, etc. These manuals were reviewed for content, accuracy and compliance with regulatory requirements.

The Spill Prevention, Control and Countermeasure (SPCC) Plan must be prepared in accordance with good engineering practices and clearly address operating procedures that prevent spills, control measures installed to prevent a spill from reaching navigable waters, and countermeasures to contain, clean up, and mitigate the effects of an oil spill that reaches navigable waters. A SPCC Plan must include a demonstration of management's approval and must be certified by a licensed professional engineer.

Venoco's Spill Prevention, Control and Countermeasure (SPCC) Plan for the EOF dated November 11, 2004 was reviewed and appeared to address all areas required by EPA.

The frequency of process risk management assessment should be done every 3 to 5 years based on incidents or accidents, process changes, etc. The PHA is used to identify the safety related weaknesses in a process, its equipment design, its operating practices and procedures, its maintenance practices, etc. Recommendations are proposed to address any weak spots that pose an intolerable risk to personnel, property, or the environment.

The Process Hazards Analysis for Ellwood Facilities, Final Updated Revision 1 dated May 2000 prepared by Arthur D. Little, Inc. and the Revalidation of the Hazard and Operability Study of the Ellwood Onshore Facility and Marine Terminal dated June 2004 prepared by IoMosaic Corporation were both reviewed. Both the original study and revalidation were professionally prepared using the HAZOP methodology with guide words, thorough in scope and appeared to address all areas required.

The Storm Water Pollution Prevention Plan (SWPPP) objectives are to identify and evaluate sources of pollutants and to identify and implement site specific best management practices to reduce or prevent discharge of said pollutants. Venoco's Storm Water Pollution Prevention Plan (SWPPP) and Monitoring and Reporting Plan (MRP) meets the general permit requirements for the discharge of storm water to the Pacific Ocean as required by the State Water Resources Control Board (SWRCB). Both SWPPP and MRP plans were reviewed at

the EOF and appeared to address all State Water Resources Control Board (SWRCB) requirements.

5.5 Training, Drills, and Applications:

Venoco has an ongoing training program for EOF personnel and contractors that include the required regulatory training. This training includes: confined space entry, oil spill drills, hazardous communications, HAZWOPER, hot/safe work permitting, H₂S, lockout / tagout, and personal protective equipment. The program appears to address all mandatory training as required by the MRMD, OSHA and the Office of Spill Prevention and Response. VENOCO maintains a computerized Employee Class History file for each employee which is a training matrix showing courses, pass/fail status, class date and retraining date. This is a complete program that is both well defined and effective.

Drills, exercises, and safety meetings are conducted following a defined schedule. Training, and pre-job safety meetings are also recorded and the records are retained for a predetermined amount of time. Venoco's safety program utilizes the Tap Root procedure to investigate incidents of a serious nature and encourages employees to fill out Safety Observations for less serious incidents. Both Safety Incidents and Safety Observations are disseminated to employees via E-mail. Employee participation in the safety program is encouraged and monitored by management and supervision. An individual's commitment to safety and their involvement in the program is linked to annual bonuses. Company personnel recognize the importance of PPE and that the requirements are strictly enforced. There were no action items identified regarding these safety elements.

Human Factors

6.0 HUMAN FACTORS AUDIT:

6.1 Goals of the Human Factors Audit:

The primary goal of the Human Factors Team is to evaluate the operating company's human and organizational factors by using the Safety Assessment of Management Systems (SAMS) interview process. The SAMS is planned to be conducted following audits of the three state lease facilities. Results of this team's work will be considered confidential between CSLC, and Plains Exploration and Production Company and will be contained in a separate report.

SAMS was developed under the sponsorship of government agencies and oil companies from the United States, Canada, and the United Kingdom to assess organizational factors, enabling companies to reduce organizational errors, reduce the risk of environmental accidents, and increase safety. The assessment was divided into nine major categories to examine the following areas (The number of sub-categories or areas of assessment for each category are included in parentheses.):

- Management and Organizational Issues (9),
- Hazards Analysis (9),
- Management of Change (8),
- Operating Procedures (7),
- Safe Work Practices (5),
- Training and Selection (14),
- Mechanical Integrity (12),
- Emergency Response (8), and
- Investigation and Audit (9).

Assessment of each of the sub-categories is derived from one main question with a number of associated and detailed questions to help better define the issues.

The SAMS process is not intended to generate a list of action items. Its purpose is to provide the company with a confidential assessment of where it stands in developing and implementing its safety culture and a benchmark for future assessments.

6.2 Human Factors Audit Methodology:

The CSLC Mineral Resources Management Division will schedule the SAMS interviews with the operator's staff and sub-contractors in coming months. The assessors will evaluate the responses based on SAMS guidelines and develop a separate confidential report for the operating company. The MRMD staff will provide the confidential report accompanied by a formal presentation that summarizes the report.

Appendices

TEAM MEMBERS

EQUIPMENT FUNCTIONALITY AND INTEGRITY TEAM

CSLC – MRMD	Mark Steinhilber Dave Rodriguez Mark LeClair P.W. Lowry Steve Staker Daryl Hutchins Craig Webster
Veneco	Jeff MacDonald Robert Van Nostrand Walt McCarty Robert Williams Dennis Lowrey

TECHNICAL TEAM

CSLC – MRMD	Mark Steinhilber Dave Rodriguez Mark LeClair P.W. Lowry Steve Staker Daryl Hutchins Craig Webster
Veneco	Jeff MacDonald Robert Van Nostrand Walt McCarty Robert Williams Dennis Lowrey

ADMINISTRATIVE TEAM

CSLC – MRMD	Mark Steinhilber David Rodriguez Mark LeClair P.W. Lowry Steve Staker Daryl Hutchins Craig Webster
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Veneco

Jeff MacDonald
Robert Van Nostrand
Walt McCarty
Dennis Lowrey

ELECTRICAL TEAM

Power Engineering
Services (PES)

Doug Effenberger
Larry Collins

Veneco

Jeff MacDonald
Robert Van Nostrand
John Dimizio
Mike Hjelm

ACRONYMS

ADM	Administration
ANSI	American National Standards Institute
API	American Petroleum Institute
BAT	Best Achievable Technology
CEC	California Electrical Code
CFC	California Fire Code
CSLC	California State Lands Commission
EFI	Equipment Functionality and Integrity
ELC	Electrical
ESD	Emergency Shutdown
ESP	Electric Submersible Pump
FSL	Flow Safety Low
FSV	Flow Safety Valve
HF	Human Factor
H ₂ S	Hydrogen Sulfide
kVA	KiloVolt Amperes
kW	Kilowatts
LACT	Lease Automatic Custody Transfer
MOC	Management of Change
MRMD	Mineral Resources Management Division
NEC	National Electrical Code
NFPA	National Fire Protection Association
OSHA	California Occupational Safety & Health Administration
OSPR	Office of Spill Prevention and Response
P&ID	Piping and Instrumentation Diagrams
PHA	Process Hazard Analysis
PM	Preventative Maintenance
PPE	Personal Protective Equipment
PRC	Public Resources Code
PSH	Pressure Safety High
PSHL	Pressure Safety High-Low
Psi	Pounds per Square Inch
PSL	Pressure Safety Low
PSM	Process Safety Management
PSV	Pressure Safety Valve
RP	Recommended Practice
SAFE	Safety Analysis Function Evaluation
SAC	Safety Analysis Checklist
SAMS	Safety Assessment of Management Systems
SCADA	Supervisory Control and Data Acquisition
SCBA	Self Contained Breathing Apparatus
SCE	Southern California Edison
SSV	Surface Safety Valve
TEC	Technical
UBC	Uniform Building Code
UFC	Uniform Fire Code
VSD	Variable Speed Drive

REFERENCES

GOVERNMENT CODES, RULES, AND REGULATIONS

- Cal OSHA California Occupational Health and Safety
- 3215 *Means of Egress*
 - 3222 *Arrangement and Distance to Exits*
 - 3225 *Maintenance and Access to Exits*
 - 3308 *Hot Pipes and Hot Surfaces*
 - 3340 *Accident Prevention Signs*
 - 5189 *Process Safety Management of Acutely Hazardous Materials*
 - 6533 *Pipe Lines, Fittings, and Valves*
 - 6551 *Vessels, Boilers and Pressure Relief Devices*
 - 6556 *Identification of Wells and Equipment*
- CCR California Code of Regulations
- 1722.1.1 *Well and Operator Identification*
 - 1774 *Oil Field Facilities and Equipment Maintenance*
 - 1900-2954 *California State Lands Commission, Mineral Resources Management Division Regulations*
- CFR Code of Federal Regulations
- 29 CFR *Part 1910.119 Process Safety management of Highly Hazardous Chemicals*
 - 30 CFR *Part 250 Oil and Gas Sulphur Regulations in the Outer Continental Shelf*
 - 33 CFR *Chapter I, Subchapter N Artificial Islands and Fixed Structures on the Outer Continental Shelf*
 - 40 CFR *Parts 112, Chapter I, Subchapter D Oil Pollution Prevention*
 - 49 CFR *Parts 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standard*
 - 49 CFR *Parts 195, Transportation of Liquids by Pipeline*

INDUSTRY CODES, STANDARDS, AND RECOMMENDED PRACTICES

- ANSI American National Standards Institute
- B31.3 *Petroleum Refinery Piping*
 - B31.4 *Liquid petroleum Transportation Piping Systems*
 - B31.8 *Gas Transmission and Distribution Piping Systems*
 - Y32.11 *Graphical Symbols for Process Flow Diagrams*
- API American Petroleum Institute
- RP 14B *Design, Installation and Operation of Sub-Surface Safety Valve Systems*

- RP 14C *Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms*
- RP 14E *Design and Installation of Offshore Production Platform Piping Systems*
- RP 14F *Design and Installation of Electrical Systems for Offshore Production Platforms*
- RP 14G *Fire Prevention and Control on Open Type Offshore Production Platforms*
- RP 14 H *Uses of Surface Safety Valves and Underwater Safety Valves Offshore*
- RP 14J *Design and Hazards Analysis for Offshore Production Facilities*
- RP 51 *Onshore Oil and Gas Production Practices for Protection of the Environment*
- RP 55 *Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide*
- RP 500 *Classifications of Locations for Electrical Installations at Petroleum Facilities*
- RP 505 *Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2*
- API 510 *Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration*
- RP 520 *Design and Installation of Pressure Relieving Systems in Refineries, Parts I and II*
- RP 521 *Guide for Pressure-Relieving and Depressuring Systems*
- RP 540 *Electrical Installations in Petroleum Processing Plants*
- RP 550 *Manual on Installation of Refinery Instruments and Control Systems*
- RP 570 *Piping Inspection Code*
- RP 651 *Cathodic Protections of Aboveground Petroleum Storage Tanks*
- Spec 6A *Wellhead Equipment*
- Spec 6D *Pipeline Valves, End Closures, Connectors, and Swivels*
- Spec 12B *Specification for Bolted Tanks for Storage of Production Liquids*
- Spec 12J *Specification for Oil and Gas Separators*
- Spec 12R1 *Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Production Service*
- Spec 14A *Subsurface Safety Valve Equipment*

ASME American Society of Mechanical Engineers

Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Divisions 1 and 2

ISA Instrument Society of America

- 55.1 *Instrument Symbols and Identification*
- 102-198X *Standard for Gas Detector Tube Units – Short Term Type for Toxic Gases and Vapors in Working Environments*
- S12.15 *Part I, Performance Requirements, Hydrogen Sulfide Gas Detectors*
- S12.15 *Part II, Installation, Operation, and maintenance of Hydrogen Sulfide Gas Detection Instruments*
- S12.13 *Part I, Performance Requirements, Combustible Gas Detectors*

S12.13	<i>Part II, Installation, Operation, and Maintenance of Combustible Gas Detection Instruments</i>
NACE	National Association of Corrosion Engineers
RPO169	<i>Control of External Corrosion on Underground or Submerged Metallic Piping Systems</i>
NFPA	National Fire Protection Agency
20	<i>Stationary Pumps for Fire Detection</i>
25	<i>Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems</i>
70	<i>National Electric Code</i>
704	<i>Identification of the Hazards of Materials for Emergency Response</i>
CEC	California Electric Code