FINAL REPORT ON THE AUDIT OF THE ALAMITOS POWER PLANT

CONDUCTED UNDER GENERAL ORDER 167
TO DETERMINE COMPLIANCE WITH
OPERATION, MAINTENANCE, AND LOGBOOK STANDARDS

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I. Executive Summary

This is the Final Report from an audit of the Alamitos Generating Station, conducted by the Consumer Protection and Safety Division (CPSD) of the California Public Utilities Commission (CPUC). Located in Long Beach, Alamitos is the second-largest fossil-fueled power plant in California, with a capacity of 1970 Megawatts (MW). CPSD audited the plant for compliance with the Commission's General Order (GO) 167, which includes Operation, Maintenance, and Logbook Standards for power plants.

CPSD auditors found sixteen potential violations of maintenance and operation standards. After extensive discussions Alamitos and CPSD resolved nine of these potential violations, after the plant agreed to take various corrective actions, including changes to work management systems, inspections of hydrogen detectors, the configuration of the chemistry lab, and maintenance of cable trays. Alamitos will also implement a formal root-cause analysis system.

Alamitos failed to demonstrate adequate programs in the remaining six areas: corrosion control, high energy piping, hydrazine management, boiler chemistry and cleaning, and thermographic testing. Alamitos also failed to provide documentation of furnace repairs.

Alamitos has agreed to develop comprehensive programs to correct these six violations within six months of the Commission's approval of this Final Audit Report, and to fully implement all six programs within another six months. CPUC also asks Alamitos to submit documentation of furnace repairs.

As it prepares its programs, Alamitos may provide drafts to CPSD for comment and review. Alamitos should make use of all available resources, including consultants where necessary, to adopt and implement clear, auditable Operation and Maintenance plans. Alamitos has failed to meet the requirements for comprehensive Operations and Maintenance plans as detailed in Section 4 of this report.

II. Background and Audit Process

Beginning September 29, 2005, a team from the Commission's Consumer Protection and Safety Division (CPSD) audited the Alamitos Generating Station ("Alamitos" or "the Plant") to determine the plant's compliance with General Order (GO) 167. GO 167 includes maintenance, operation, and logbook standards for power plants.[1] The audit team included Ben Brinkman, Steven Espinal, Winnie Ho, Chris Parkes and Alan Shinkman.

CPSD conducted the audit by reviewing plant performance data, responses to CSPD data requests and by visiting the plant site. First, the team examined outage reports by CPSD staff, as well as databases maintained by the California Independent System Operator (ISO)

[1] Further information on the Commission's Power Plant Performance program may be found at the Commission's Web Site at
http://www.cpuc.ca.gov/PowerPlantStandards.

and the North American Electric Reliability Corporation (NERC). On September 29, 2005, the team notified the plant of the audit. The team visited the plant site from October 31, 2005 to November 4, 2005, examining documents, interviewing staff, inspecting equipment, and observing operations. At the conclusion of the site visit, the team presented the plant with a data request. CPSD sent the plant additional data requests on December 5, 2005 and December 22, 2005.

CPSD sent Alamitos a Preliminary Audit Report on February 2, 2007, and directed Alamitos to submit a Corrective Action Plan (CAP) by March 2, 2007. Alamitos requested an extension, and submitted a CAP on March 15, 2007.

This audit required special effort to resolve a number of issues. On April 30, 2007 CPSD sent Alamitos a letter listing deficiencies in the CAP. To resolve the deficiencies, CPSD conducted a conference call on May 22, 2007, a second on-site visit on June 21, 2007, additional conference calls on October 16, 2007 and November 1, 2007, and a meet and confer session on January 17, 2008.

III. Audit Scope

A. Plant Description

The second-largest fossil-fueled power plant in California, the Alamitos Generating Station, is located in Long Beach, on Studebaker Road. The 1970 Megawatt (MW) plant, owned by AES Alamitos LLC, consists of six units. The units are configured in pairs, with each pair utilizing a different technology:

Unit Number	Commissioning Date	Boiler Technology
1	1956	Babcock and Wilcox natural circulation boiler
2	1957	
3	1961	Controlled circulation boiler
4	1962	
5	1964	Supercritical boiler
6	1966	

Southern California Edison built the units to meet baseload, but the units are less efficient than newer, combined cycle units, and are used only when electrical demands are relatively high. AES bought the plant in 1998, during the restructuring of California’s electric industry. In recent years, the plant’s capacity factors dipped below ten percent. In 2004-2005, Unit 3 ran more often than the others, primarily because the California Independent System Operator had designated the unit as Reliability-Must-Run (RMR). The ISO removed this designation as of January 2007.[2] According to a plant team leader, AES employs 80 people

[2] The California Independent System Operator (CAISO) had declared Unit 3 to be a Reliability Must Run (RMR) unit to preserve the stability of the grid, but concluded this contract as of 2007. From the CAISO website, RMR is “an annual process that identifies geographical areas with local reliability issues in the ISO Control Area along with measures to remediate those issues. Reliability Must Run Contracts are a means of ensuring power availability within identified areas.”

while Edison employed 265. The audit team looked at the plant's overall compliance with standards, with attention to problems identified from the plant's operating history. Although the team audited all units, the team focused on Units 3 and 4, because those units were used the most and because Unit 3 was designated RMR. The team also examined several important operating incidents in the recent past:

- In October 2004, rain entered a hole left by a missing bolt in the Unit 3 Circulating (cooling) Water Pump Junction Box, shorting out the 4 KV electrical systems for Units 3 and 4, and causing a fire in the Unit 4 switchgear.

- In November 2004, unaware of changes in piping, plant staff mistakenly routed oil into the intake channel for Units 3 and 4, which carries water between the plant and the ocean. In particular, plant staff failed to check updated piping configuration drawings when transferring used lube oil. The plant contained the spill and notified the proper authorities, according to the plant Spill Prevention, Containment and Countermeasure (SPCC) Spill Report.

- In March 2005, during a scheduled outage, a plant operator changed valve settings to allow work on the circulating (cooling) water tunnels, inadvertently flooding the Unit 5 and 6 circulating water pit. The flood damaged circulating water pumps and motors in the pit.

- In July 2005, years after a temporary repair, a pipe burst, flooding the Unit 3 and 4 circulating water pit, and damaging pumps and motors in the pit (see Finding 1). The resulting outage contributed to a Stage 2 electrical emergency. Units 3 and 4 are critical to Alamitos because they provide "start-up steam" to Units 5 and 6.

Moreover, CPSD inspected the plant for seven boiler-related outages in 2004 and 2005, including five outages for boiler tube leaks. The team audited maintenance of the steam turbine and the boiler, critical systems at all plants. More generally, the audit focused on:

1. Logbooks, training, and human resources
2. Equipment, parts, and tools
3. Chemistry
4. Regulatory compliance, engineering support, and safety including hazardous material handling, and fire and spill prevention and response
5. Maintenance planning, performance, and documentation specifically related to:
    a. Boiler tube leaks;
    b. Electrical system, specifically the main transformer, exciter and circuit breakers;
    c. Circulating (cooling) water system;
    d. Steam turbine; and
    e. Lube oil system.

Auditors inspected the plant, including all six units, the warehouse, chemistry labs, mechanical shop and electrical shop. Plant staff demonstrated the plant's maintenance management software. An auditor attended a shift change meeting (also called a tailboard meeting), and observed the control room during a unit start-up.

B. Plant Performance

Data from 2003 to 2007[3] show that infrequent, high-impact failures, discussed below, forced Alamitos' units offline for large periods of time, often during periods of peak demand. In some cases, these failures had only a limited effect on the usual measures of plant performance. Those measures show to what degree the plant is available (measured by the Equivalent Availability Factor or EAF), or conversely, forced off-line for unplanned repairs when the system operator needs the plant to generate power (measured by the Equivalent Forced Outage Rate in times of demand or EFORd). A higher EAF indicates better performance than a lower EAF, while a higher EFORd indicates poorer performance than a lower EFORd. In particular, Units 3 and 4 both performed poorly during 2004 and 2005, as described below. However, averaging the data from these units over a longer period of time suggests that they performed as well or better than comparable California units. CPSD notes that Alamitos instituted a program to mitigate or avoid high impact events (Observation 9). Like many conventional boiler units in California, all Alamitos units ran at low capacity factors.

Units 1 and 2 performed approximately the same as similar California units, and in fact showed a slightly better equivalent forced outage rate under demand (EFORd) and forced outage factor (FOF).[4] Units 1 and 2 recorded an EFORd of 15% in 2004 (compared to the California average of around 9%), partly due to a small electrical fire and some boiler tube leaks. In recent years, the ISO dispatched these units less frequently than previously, as more efficient plants became available. In 2005 and 2006 the net capacity factor for these units, which shows how much the units generate, fell below 5%. The average factor for comparable California units is approximately 12%.

Units 3 and 4 both performed badly in 2004 and 2005. In 2004, Unit 3's and Unit 4's EFORd increased to 25% and 15% respectively, primarily due to two extended forced outages caused by the October 2004 electrical fire, which forced Units 3 and 4 offline for months. While Unit 4 returned to service in 2004, repairs rendered Unit 3 unavailable until early 2005. As a result, in 2005 Unit 3's EFORd spiked to 35%.

When needed by the CAISO, Units 5 and 6 performed as well as or better than typical California plants, as measured by EFORd. In 2004, Unit 6's EFORd fell below 1.0%. Due to turbine overhauls, the equivalent availability factors (EAF) for Units 5 and 6 fell below 70% in 2005 and 2004 respectively. The March 2005 pit floods caused that quarter's EFORd

[3] CPSD looked at six performance metrics monitored by the North American Electric Reliability Corporation (NERC) which included (1) Equivalent forced outage rate during demand (EFORd), (2) Equivalent Availability Factor (EAF), (3) Starting Reliability (SR), (4) Net Capacity Factor, (5) Forced Outage Factor (FOF), (6) and Scheduled Outage Factor (SOF).

[4] EFORd measures the equivalent fraction of power unavailable during periods when a unit is needed. FOF measures the fraction of power unavailable during an entire operating period. Lower numbers are better for both measurements.

to spike to 20%, mostly offset by better performance for the remainder of the year. The Unit 5 EFORd increased above 10% in 2006, with no obvious explanation.

IV. Corrective Actions Required

Alamitos has agreed to develop and implement comprehensive programs to address CPSD's six most critical findings:

> Finding 1. The plant lacks a program to systematically prevent, detect, and repair corrosion.
>
> Finding 2. The plant lacks an adequate program for maintaining high-energy piping.
>
> Finding 3. The plant fails to adequately manage hydrazine, a hazardous material.
>
> Finding 4. The plant fails to effectively manage boiler chemistry alarms and controls.
>
> Finding 6. The plant fails to chemically clean boilers despite leaks.
>
> Finding 11. The plant lacks a complete testing program for relays and circuit breakers.

Alamitos has agreed to develop the above comprehensive programs within six months of the date the Commission approves this Final Audit Report, and to implement the programs within one year of that date. These comprehensive programs should include:

- clear monitoring guidelines, including:
    - A list or a set of criteria specifying which equipment or processes Alamitos will monitor,
    - Drawings and schematics of systems,
    - A schedule or a set of criteria specifying when Alamitos will inspect each piece of equipment or process,
    - A set of procedures specifying the tests and inspections Alamitos will perform, including the method for each (e.g. thermography, ultrasound, borescopy),
    - A set of criteria specifying what results will require which action(s),
    - Procedures for documenting issues and decisions where test or inspection results fall into an area where professional judgment is required, and
- Sufficient documentation to show that Alamitos has implemented the program fully including timely follow-up.

As it prepares its programs, Alamitos may provide drafts to CPSD for comment and review. Alamitos should make use of all available resources, including consultants where necessary, to adopt and implement clear, auditable Operations and Maintenance plans. Alamitos has failed to meet the requirements for comprehensive Operations and Maintenance plans.

CPSD emphasizes its findings are not simply a list of problems that Alamitos should correct; rather, these findings are evidence that the plant lacks comprehensive programs in these areas. A plan will be comprehensive not only if it addresses and corrects the problems identified in the findings, but also provides an overall strategy to comply with the Operations and Maintenance standards. If Alamitos fails to adopt and implement adequate Operations and Maintenance plans, it may be subject to enforcement action.

For an additional finding, CPSD requires documentation of repairs:

Finding 13. The plant failed to schedule or complete furnace repairs.

Alamitos reported that it spent approximately two million dollars on furnace repairs, but the plant has yet to provide documentation, despite multiple CPSD requests. CPSD requests that the Commission order Alamitos to provide this documentation.

Alamitos and CPSD resolved the remaining nine findings. While not admitting specific violations of the Maintenance and Operations Standards, the plant agreed to take various corrective actions as described in Section 6 below. CPSD will follow up as necessary.

V. Safety Hazards Requiring Immediate Corrective Action

CPSD found no safety hazards which required immediate corrective action.

VI. Potential Violations Requiring Corrective Action

Finding 1: The plant lacks a program to systematically prevent, detect and repair corrosion.

The plant lacks and has lacked for many years a program to systematically prevent, detect and repair corrosion, a potential violation of maintenance and operations standards.[5] While the plant has recently commissioned inspections that document multiple examples of corrosion at the plant[6], the plant's actions fall far short of a comprehensive and effective program. First, the plant's cathodic protection system, a basic component of reasonable maintenance at any power plant, is out of order or malfunctioning in at least four of the

[5] Operations Standard 27 – Flow Assisted Corrosion; Maintenance Standard 7 - Balance of Maintenance Approach, Guidelines B, E, and L; Maintenance Standard 13 – Equipment Performance and Materiel Condition, Guidelines H and N.

[6] Alamitos hired a retired power plant manager who had 30 years of experience with Southern California Edison to inspect various areas of the plant. During August and September 2005, he submitted a number of inspection reports, organized by system, which the plant stored in one or more binders. While a table of contents lists those systems, pages lack numbers and bear various dates.

plant's six units. Second, the plant failed to make proper repairs to corroded piping, causing an outage and contributing to a statewide Stage 2 emergency. Third, despite this history, the plant still lacks a comprehensive program to detect and repair corrosion, conducting limited inspections, misprioritizing repairs, and making questionable repairs.

Cathodic protection is an important corrosion protection system, and a basic component of reasonable maintenance at any power plant. Cathodic protection systems send electrons into plant components such as steel piping to prevent those components from oxidizing. Passive systems attach "sacrificial anodes," made of materials which themselves corrode and donate electrons to the material being protected. Active systems, called "impressed current cathodic protection," send a direct current (composed of electrons) into the material. A rectifier converts alternating current into a direct current, which then flows from the rectifier to the piping. The plant must monitor and replace sacrificial anodes and maintain rectifiers for the systems to work as designed.

The plant's cathodic protection system is out of order or malfunctioning in at least four of the plant's six units. One of the plant's team leaders told auditors that cathodic protection equipment was completely out of service in the Units 3 and 4 circulating (cooling) water system. His comments mirror the results of the inspections commissioned by the plant.[7] The rectifier for Unit 1 through 4 was out-of-service.

The plant ignored a 2002 inspection report concerning corroded pipe; three years later the pipe burst, flooding a pit filled with critical equipment, and putting the plant out-of-service during a statewide Stage 2 electrical emergency. The plant uses Filemaker to schedule and track preventive maintenance, corrective maintenance including repairs, and to plan extended outages. A workorder or Work Tracking Form (WTF) from the plant's computerized maintenance management system, dated December 28, 2002 and retired January 28, 2003[8], states:

> <u>*Work Required*</u>
> *[Unit] 3 West discharge pipe at the structure wall is starting to rust through and will be leaking shortly. Please inspect and plan to repair.*
> <u>*Work Summary*</u>
> *Temp patch with belzona from #4 e repair.*

Auditors found no evidence that the plant took subsequent action. The plant neither studied the cause of corrosion in the pipe, nor took further corrective action beyond the temporary patch. As discussed elsewhere in this report, the pipe failed in July 2005, flooding a pit filled with critical equipment including circulating (cooling) water pumps and motors, and putting Units 3 and 4 out-of-service during a statewide Stage 2 alert. This outage removed 660 megawatts from service even as the ISO asked utilities to interrupt 230 megawatts to

[7] See the binders of consultant inspection reports, Unit 1 and 2 inspection Item 12, listed in the table of contents as "Cathodic Protection." The page itself is titled "Alamitos 1 thru 4 Cathodic Protection." The section is duplicated for Units 3 & 4.
[8] Work Tracking Form (WTF) 0201751.

"interruptible" customers, those who had agreed to allow such interruptions in return for discounted electricity rates[9].

The plant still lacks a comprehensive program to detect and repair corrosion. The plant fails to conduct adequate inspections. The plant made a questionable repair to Units 3 and 4, pouring concrete around a broken pipe. The circulating water system in Units 1 and 2 is at risk of failure due to corrosion. The plant has misprioritized work orders.

The plant continues to fail to inspect equipment adequately. Following the outage at Units 3 and 4, the plant asked Edison ESI to study the failure. In an evaluation report dated August 31, 2005, Edison ESI found the likely cause of the failure was corrosion at the junction between steel and concrete. The failure occurred close to the entry of a circulating water pipe into a concrete wall. Using piping wall thickness measurements taken by the International Energy Services Company (IESCO), Edison ESI determined that the wall thickness of exposed pipe (that is, pipe not surrounded by concrete) near the failure met minimum requirements.[10] The Edison ESI report noted that some areas of piping experienced noticeable wall loss. This report recommended visual and ultrasonic inspection of normally inaccessible pipes (e.g., those encased by concrete), especially at any junctions of pipe and concrete, where accelerated corrosion occurs. However, a team leader told the auditor that the plant plans only a visual inspection of this piping.

The plant's repair to the pipe break at Units 3 and 4 is questionable. The plant simply poured a concrete block around the affected pipe. The plant provided no studies, however, indicating whether pouring concrete would prevent future failure.

Units 1 and 2 may fail because of corrosion. A consultant's inspection report for Units 1 and 2 stated, "The circulating [cooling] water system is the highest risk of failure in the units 1 and 2 area." The report recommended immediate repair of a "line [in Unit 2 which] has a large rusted and corroded spot which may blow out."[11]

The plant's work orders do not reflect the relative priority of corrosion protection work. For example, work orders to implement most of the consultant's recommendations do not appear in Filemaker. Existing work orders require repair of cathodic protection connections on specific parts of the system, such as traveling screens, but the plant provided no work orders to repair rectifiers, which CPSD believes is a much higher priority. Nor has the plant addressed corrosion found at other locations at the plant, including the main gas supply line for Units 5 and 6.[12]

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[9] CAISO news release dated July 21, 2005, "California ISO Issues A Stage Two Electrical Emergency In Southern California Only After Equipment Failure At Several Power Plants." CAISO Load Reduction Data, Revised 7/17/2008, lists approximately 230 MW of interruptible load reduction on 7/21/2005.
[10] The August 31, 2005 Edison ESI report references inspections from an International Energy Services Company (IESCO) report dated August 8-10, 2005.
[11] See the binder of consultant inspection reports. The quote appears on the third page of this material (the page is unnumbered).
[12] See binders of inspection reports. The report is listed in the table of contents for Units 5 and 6 as "Main Gas Supply Line." The report itself is titled, "Alamitos Units 5 and 6 Main Gas Yard Header."

Finally, it is not clear that these recent consultant reports represent comprehensive analyses of work needed at the plant. The plant provided no documentation on other piping or concrete pipe contacts at the plant. The plant's inspector and CPSD auditors observed corrosion at various plant locations (see Figures 1 and 2). The significance of these particular observations can only be assessed as part of a structured program of inspection, testing and evaluation.

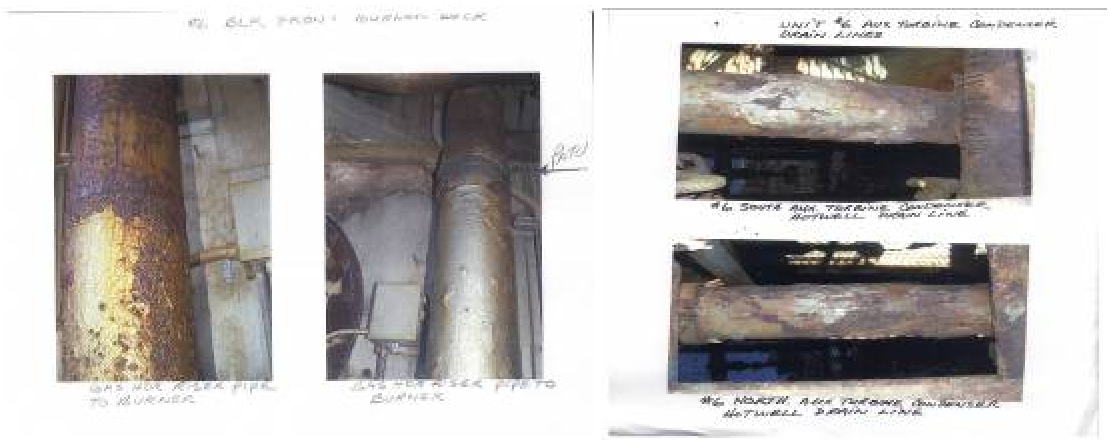

Figure 1. Corrosion on Unit 6 gas system and auxiliary turbine condenser hotwell drain lines.

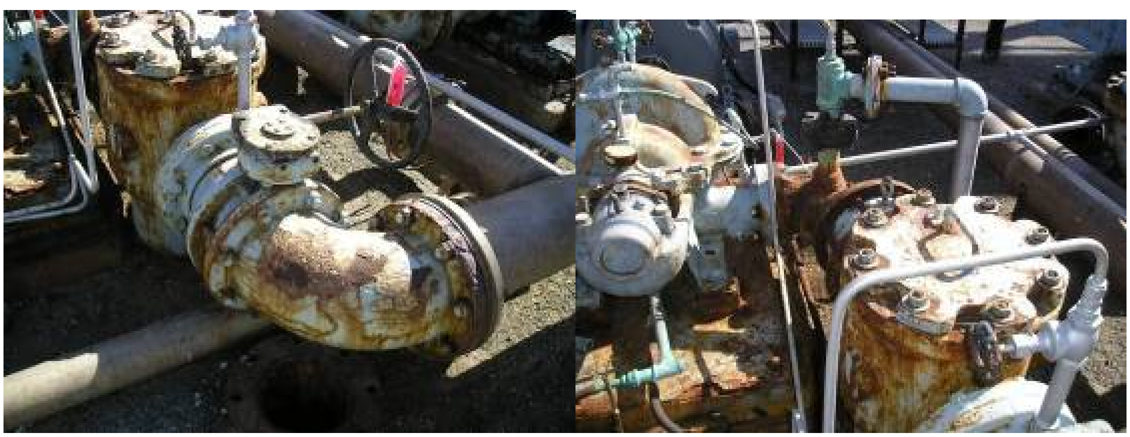

Figure 2. Corrosion at the plant.

Outcome and Follow-up

Since the initial audit visit, the plant has undertaken certain corrosion protective measures, including adding leak detectors, repairing some piping, repainting other pipes, and submitting some inspection procedures and records. However, the plant's response remained piecemeal. Below are some examples of the improvements at Alamitos, along with examples of specific deficiencies that a comprehensive corrosion control program should address.

First, although the plant created a two page "Corrosion Protection Program" dated July 12, 2007, the program lacks a schedule for scope, type, criteria and frequency for inspections and maintenance. The document fails to specify how the plant will inspect and maintain various systems, for example, circulating water (including wrapped piping), bearing cooling water, condensate, fuel gas, and cathodic protection.

Second, although the plant created a work order to test its cathodic protection system, it still lacks a comprehensive cathodic protection program. Alamitos sent CPSD its standard checklist for testing cathodic protection, containing test readings taken on June 18, 2007, just before a CPSD site visit.[13] The plant left several readings blank, and the form failed to specify acceptable measurement ranges. The form shows that the plant repaired the power supply to the anodes.

Third, the plant's cathodic protection system may not be intact. According to plant staff a loose wire in the Unit 5 and 6 circulating water pit used to be part of the cathodic protection system. Auditors found only a rough diagram of the system, rather than a detailed schematic. The cathodic protection work order (referenced above) states that Alamitos had contracted for a cathodic protection survey. CPSD expects that Alamitos will incorporate the results of that survey into the plant's cathodic protection program.

Finally, the plant's program does not take into account the August 31, 2005 Edison ESI report that metal and concrete interfaces corrode quickly. This is of particular concern because the plant repaired severely corroded pipe by encasing it in concrete, retaining the metal-concrete interface while making access for testing or repairs difficult. Further, corrosion at such an interface caused a pipe break at another AES facility in 2007.

Finding 2: The plant lacks an adequate program for maintaining high-energy piping.[14]

The plant lacks an adequate program for maintaining high-energy piping, a potential violation of maintenance and operations standards.[15] Explosive failure of such piping, while rare, can injure or kill workers nearby and cause extensive damage to plant equipment. Auditors noted three potential deficiencies.

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[13] Work Tracking Form (WTF) PW000188 "Cathodic Protection Routine Survey". Created 1/30/2007, Retired 6/18/2007.

[14] High energy piping is potentially dangerous because it carries very hot, highly pressurized water or steam.

[15] Operations Standard 27 – Flow Assisted Corrosion; Maintenance Standard 7 - Balance of Maintenance Approach, Guidelines B, E and L; Maintenance Standard 13 – Equipment Performance and Materiel Condition, Guidelines H and N.

First, at least on Unit 3 and Unit 5, the plant failed to perform an important stress analysis of the high-energy piping systems. A contractor report for these units[16], dated February 2005, notes changes in piping supports and states:

"*…it is extremely important to periodically perform a stress analysis of the system to assure that these changes have not adversely affected the stress levels. It is recommended that such an analysis be performed on the Main Steam and Cold Reheat lines in the immediate future.*"

The plant provided no documentation showing completion of these stress analyses or subsequent repairs.

Further, the contractor states that some pipe wall thicknesses are adequate, but only assuming no further corrosion, a statement that indicates that repairs are necessary.[17] The plant gave auditors no documentation showing that it had repaired the marginal pipe.
Finally, many former SCE plants inspect high-energy piping annually, but Alamitos prefers inspections every two years for some units.[18]

<u>Outcome and Follow-up</u>
While the plant sent CPSD contractor inspection reports, the plant failed to adopt a comprehensive program for high-energy piping inspection and maintenance. The plant continues to rely on contractors, without a plant-defined schedule, scope, or criteria for action. The plant cannot delegate responsibility for operation and maintenance standards to contractors. To compound the problem, the plant fails to implement important contractor recommendations, making it even less clear what standards apply at the plant. Leaks continue at Alamitos. For example, in June 2007, auditors on the ground heard a loud steam leak high overhead at one of Alamitos's supercritical units. Below, we discuss a few examples of continued problems at the plant.

First, the plant failed to correct bottomed- and topped-out pipe hangers mentioned in contractor reports.[19] These deficiencies cause stress to the system's high-energy piping system, which may explode catastrophically.

Second, the plant failed to follow the contractor's recommendations to analyze stresses on pipes, even though the plant corrective action plan states that "AES follows all engineering

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[16] AES Alamitos Generating Station Unit 3 and Unit 5 Critical Piping Inspection February 2005 summaries from Edison ESI. The Unit 5 report also recommended that the plant perform a stress analysis on the Hot Reheat lines.
[17] AES Alamitos Generating Station Unit 3 and Unit 5 Critical Piping Inspection February 2005 summaries from Edison ESI: "Wall thickness measurements below minimum wall with corrosion allowance equal to 0.0625 inch were found. All wall thickness measurements are above minimum wall with corrosion allowance equal to zero."
[18] Email from Richard Serpa at Edison to Pedro Rodriguez, dated January 26, 2005, 10:45 a.m. "Critical Piping Inspections for AES Alamitos Units 1 and 2". Alamitos sent this memorandum to auditors.
[19] AES Alamitos Generating Station Unit 3 and Unit 5 Critical Piping Inspection February 2005 summaries from Edison ESI. The Unit 5 report also recommended that the plant perform a stress analysis on the Hot Reheat lines.

recommendations."[20] At the same time, the plant failed to provide its own criteria for when to perform stress analysis.

Third, the plant failed to adopt a plan for managing corrosion. As discussed above, a contractor found that current pipe thicknesses were acceptable only if no further corrosion occurred. The plant manager stated that current wall thicknesses are acceptable because the units run infrequently. CPSD is concerned that such a conclusion is unjustified, unless the plant measures current corrosion rates, extrapolates them over expected run times, and compares predicted wall thicknesses to pre-defined acceptable levels.

Fourth, the plant's contractors have yet to look at various problematic plant components. On February 27, 2007, at a thermowell, a dissimilar metal weld failed, causing a high pressure/temperature steam leak at AES Huntington Beach. No one was injured, but the leak was potentially lethal. AES's report states[21]:

> *The critical piping inspection vendor used within AES Southland, Edison ESI, specifically builds their inspection scope around pipe-to-pipe welds. Events like the one documented here prove there is considerable risk associated with all welds connected to high energy piping such as thermowells, gamma plugs, warm-up lines, etc and should be specifically included in annual inspections. HBGS had been relying on Edison ESI to build an inspection scope which encompasses the risk areas on our high energy piping and it is clear these smaller welds do not receive the proper attention. HBGS will re-establish program expectations with ESI and include all welds in future inspections.*

Further, according to AES's contractor[22], at least one major boiler manufacturer has released a bulletin recommending inspection of high-temperature threaded connections. In short, AES must adopt a program which monitors research and manufacturer bulletins, and includes all potentially risky components.

Finally, the plant fails to follow through on various required repairs. For example, a November 2006 contractor report[23] stated that "bent sway brace extension rods" found in 2001 and 2003 walk-downs had not yet been repaired.

Finding 3: The plant fails to adequately manage hydrazine, a hazardous material.

The plant failed to adequately manage hydrazine, a hazardous material, a potential violation of operation and maintenance standards.[24] Hydrazine is an oxygen scavenger which

[20] "Response of AES Alamitos LLC to the Preliminary Audit Report for the Alamitos Power Plant", received March 15, 2007.
[21] AES Huntington Beach Event Summary Report, dated March 16, 2007.
[22] Edison Report: "Subject: AES Huntington Beach – Evaluation and Repair of Dissimilar Metal Welds (DMW's) on the Main Steam Lines of Units 1 and 2," dated June 26, 2007.
[23] AES Alamitos Generating Station Unit 1 Critical Piping Inspection November 2006 summary.
[24] Maintenance Standard 1-Safety; Maintenance Standard 3 –Maintenance Management and Leadership, Guideline E – Follow-up, Reinforcement and Feedback; Maintenance Standard 7-Balance of Maintenance

Alamitos continuously adds to the boiler water to reduce corrosion. The plant lacked proper handling procedures for hydrazine, failed to report hydrazine use to the appropriate local agencies, and released fumes into the work area without adequate venting.

The plant lacked proper handling, storage, and monitoring processes and procedures for hydrazine. The plant lacked the Material Safety Data Sheet (MSDS sheet) that prescribes proper handling, storage, and exposure controls for hydrazine. This sheet is a prerequisite to adoption and implementation of an adequate hydrazine management program.

The plant had not reported the chemical to the appropriate local agencies, which need the information to review emergency response, preparedness, and contingency plans in the event of hazardous materials release. State law requires the plant to complete a separate Hazardous Materials Inventory – Chemical Description (form 2731) for each hazardous material handled at the facility exceeding specific threshold quantities. For liquids, this threshold is 55 gallons. At the request of CPSD, Alamitos provided the form, listing the average daily amount of hydrazine at the site as 0.5 gallons. However, auditors believe that the plant maintains an inventory clearly larger than 0.5 gallons and very likely larger than 55 gallons. Figure 3 shows a hydrazine mixing tank well over 100 gallons, as well as several 55 gallon drums some of which appear to contain hydrazine. Power plants typically carry inventories of hydrazine in the hundreds of gallons.

Figure 3. Hydrazine mixing and storage area appears capable of storing over 100 gallons of hydrazine.

During the plant visit, the plant's steam jet air ejector released fumes into the work area without adequate venting**.** On the first day of the audit, the auditor smelled strong fumes on the lower level of Unit 3. When the auditor asked about the fumes, the team leader explained that the fumes came from the steam jet air ejector that exhausts oxygen and gasses from the condenser. The plant leader said the fumes were hydrazine. An automatic system (the hydrazine injector) normally controls the boiler water concentration level at 7 ppb. However, a staffer put the controller into manual operation, sending hydrazine levels to 50 ppb. Fumes

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Approach; Operations Standard 1-Safety; Operations Standard 4 – Problem Resolution and Continuing Improvement, Guideline B – Problem Reporting, Root-Cause Analysis, and Corrective Actions; Operations Standard 10-Environmental Regulatory Requirements traveled from the steam jet air ejector in the auxiliary bay into other areas of the plant, including the control room. After workers reported the fumes, Alamitos taped a long hose onto the exhaust of the steam jet air ejector to route the fumes to the outside of the building (Figures 4 and 5). Alamitos installed a large fan at the doorway of the building to exhaust fumes that had already been released inside the building.

Figure 4. The plant taped a hose to the steam jet air ejector to exhaust fumes.

Figure 5. The hose from the steam jet air ejector extends through the auxiliary bay.

Temporary installation of a hose and fan to disperse hydrazine fumes release is inadequate to meet exposure controls prescribed in the hydrazine Material Safety Data Sheet (MSDS). Furthermore, there is evidence that fumes may have been released in the past. The auditor saw tape around the exhaust port of the steam jet air ejector for Unit 4 (see Figure 6).

Figure 6. Tape wrapped around exhaust port of Unit 4 steam jet air ejector may indicate prior release of fumes.

Many plants no longer use hydrazine because of the stringent handling, storage, and monitoring requirements prescribed in the MSDS. In addition to other health concerns, hydrazine (and its fumes) has been classified as a carcinogen. Plants can use alternative chemicals to remove oxygen from boiler water.

<u>Outcome and Follow-up</u>

Alamitos agreed to develop and implement a comprehensive program for handling and using hydrazine. In response to the Preliminary Report, the plant added piping to vent fumes outside, reduced the quantity of hydrazine onsite (see Figures 7 and 8), and created basic procedures for handling hydrazine[25] however, those preliminary procedures contain inaccuracies and need more work. Although the plant no longer believes the fumes were hydrazine, CPSD remains concerned that any potentially hazardous fumes could threaten the plant's reliability and safety. CPSD requests that the plant improve the new procedures, and update and file its emergency plans.

While Alamitos initially reported that the fumes consisted of hydrazine, the plant later stated that the fumes stemmed from oil in the boiler feedwater. After the initial reports, the plant found acetate in steam samples. The plant reported that "oil was leaking into the main boiler feed pump seal water return line to the condenser."[26] In 2008, Alamitos tested exhaust from the steam jet air ejector and found no hydrazine[27]; the detector was sensitive enough to detect hydrazine at very low levels, well below the concentration that people could smell. Alamitos further argued that hydrazine converts to other chemicals before exhausting through the air ejector. Alamitos provided no information on the safety of acetate or of oil fumes in general.

CPSD remains concerned about the fumes. First, Alamitos presumably ran later tests under normal hydrazine concentrations, rather than at the very high levels present in feedwater

[25] Unit 3 and 4 Hydrazine Day Tank Mixing Instructions Operating Instruction A-4-6; Safe Handling of Hydrazine Operating Instruction A-4-7.
[26] Email, report and notes: "Steam Purity Results" dated November 21, 2005.
[27] Email, "Unit 3 Air ejector – Hydrazine Test results" dated April 8, 2008.

during the release of fumes. Second, potentially hazardous fumes of any type threaten reliable plant operation.

After discussion with CPSD, Alamitos vented both steam air ejectors to the outside. In particular the plant installed permanent piping starting at the exhaust, passing though grating in the auxiliary bay, and ending in a vent at the building's side wall.

Figure 7. Hydrazine area at the time of the initial audit visit. The metal tote is on the left.

Figure 8. Hydrazine area after the metal tote and excess (blue) hydrazine drums were removed.

Second, after considering a less dangerous oxygen scavenger, as well as a tote system for handling hydrazine, Alamitos instead decided to reduce the quantity of hydrazine on the site. Before the audit, Alamitos installed a large tote. Tote systems generally reduce handling of and exposure to hydrazine, among other things, because staff no longer needs to clean drums, and can reuse the tote. Alamitos also considered switching from hydrazine to Eliminox, a less dangerous oxygen scavenger. Alamitos instead decided to continue using hydrazine drums, but in reduced quantities.

CPSD believes that continued use of drums has two consequences. First, Alamitos must continue to limit the number of drums on site, and to track the number of drums carefully. Second, Alamitos must adopt and implement procedures for handling hydrazine.

Alamitos's initial procedures need additional work. For example, the procedures instruct workers to wear an approved respirator if exposure to vapors or mists exceeds the Permissible Exposure Limit (PEL) of 1 ppm. However the instructions do not designate an approved respirator. Furthermore, although the OSHA PEL for hydrazine is 1 ppm, the Cal/OSHA PEL for hydrazine is 0.01 ppm, and the Cal/OSHA Short Term Exposure Limit (STEL) is 0.03 ppm.[28] Procedures also state, "Proper engineering and administrative controls should be used to reduce exposure," but fail to specify these controls.

Finally, Alamitos updated its Hazardous Materials Inventory. This form, number 2731, now shows an average and maximum inventory of 35 gallons and 140 gallons per day, respectively. However, the plant failed to check the box indicating that hydrazine is a chronic health hazard, as stated in its MSDS (Material Safety Data Sheet). Alamitos must include the corrected form in its updated safety management/emergency plan, and submit the plan to local agencies.

Finding 4: The plant fails to effectively manage boiler chemistry alarms and controls.

The plant fails to effectively manage its boiler chemistry controls and alarms, a potential violation of operation and maintenance standards.[29] During the audit, alarms for boiler water conductivity activated up to 20 times a day (Figure 9). Operators cleared the alarms without determining the cause of the alarms (for example, by investigating whether the alarms were mistuned or whether conductivity control equipment was faulty). In addition, when the auditor asked about the conductivity alarm, an operator found that two different conductivity readouts conflicted. Staff could not explain why the readouts conflicted. Further, the auditor repeatedly saw activated alarms for hydrazine a day after the reported release of that material into the work area.

[28] California Code of Regulations, Title 8, Section 5155. Airborne Contaminants.
[29] Maintenance Standard 1-Safety; Maintenance Standard 3- Maintenance Management and Leadership, Guideline E – Follow-up, Reinforcement, and Feedback; Maintenance Standard 7-Balance of Maintenance Approach; Operations Standard 1-Safety; Operations Standard 4-Problem Resolution and Continuous Improvement, Guideline B-Problem Reporting, Root-Cause Analysis, and Corrective Actions; Operations Standard 10-Environmental Regulatory Requirements.

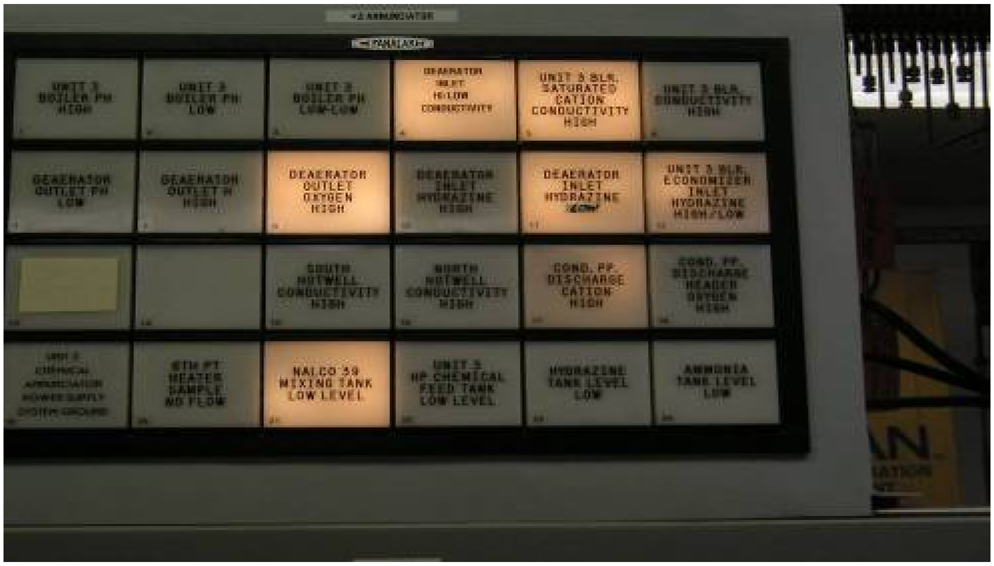

Figure 9. Hydrazine and conductivity alarms activated in the chemical lab.

CPSD is concerned for two reasons. First, if alarms are false, or improperly tuned, the alarms will unnecessarily distract plant staff. Plant staff may become desensitized to and ignore alarms that require action, causing equipment damage and safety risks. On the other hand, to the extent alarms are real; the plant fails to control water chemistry and/or the condition of equipment.

Outcome and Follow-up

The plant has agreed to develop and implement a comprehensive program for management of alarms and water chemistry. In response to the preliminary audit report, the plant stated that it has procedures for management-of-change and periodic calibration and repair of the plant's alarm system. However, CPSD is concerned that those procedures have so far failed to detect or address problems at the plant, including excessive alarms, a misconfigured conductivity sensor, repeated chemistry excursions, and resulting deposits on tubes. The plant has neither recognized these as problems, nor analyzed the root causes of the problems.

First, although the plant stated that it has a management-of-change procedure CPSD remains concerned that the procedure has proven inadequate to handle incorrect or excessive alarms. In its corrective action plan, the plant stated that load swings caused the alarms, which it considers normal.[30] Industry experience shows that operators begin to ignore excess alarms, fail to take action when required, and cause damage to plants. Under an effective program, a plant reviews alarms and staff's response to those alarms, and tunes the system periodically. In particular, the plant tests sensors, adjusts alarm setpoints, and/or reconfigures the system's response to multiple sensors.

[30] "Response of AES Alamitos LLC to the Preliminary Audit Report for the Alamitos Power Plant", received March 15, 2007.

Second, the plant's procedures failed to detect and correct the malfunctioning conductivity alarm discussed above. The plant discovered the problem only during the audit visit. The plant has not analyzed the root cause of this failure.

Third, although the plant responded that the plant's water chemistry system was functioning as designed, test data supplied to CPSD contradict any assertion that chemistry control is adequate. Some boiler tube samples were "very dirty" (see Finding 6), probably because of poor water chemistry. The plant neither cleaned the tubes nor analyzed the cause of excursions.

Fourth, the plant failed to find the root causes of excessive hydrazine in feedwater, which among other things contributes to flow-assisted corrosion. The plant did not analyze why operators put a hydrazine control in manual, but merely issued instructions prohibiting this action.

Finding 5: The plant's work management system and database are poorly managed and maintained.

The plant's work management system and database, known as "Filemaker", are poorly managed and maintained, a potential violation of maintenance and operations standards.[31] Because the plant fails to manage the Filemaker system effectively, Filemaker entries are inconsistent and full of errors. Filemaker's failure to track maintenance work interferes with the plant's operation.

The plant uses Filemaker to schedule and track preventive maintenance, corrective maintenance including repairs, and to plan extended outages:

- For each preventive maintenance activity, plant staff creates a preventive maintenance (PM) task in Filemaker, specifying how often the task should be repeated. The Filemaker system automatically generates Work Tracking Forms (WTFs) at the scheduled intervals, which tell plant staff to perform the work.
- For each corrective maintenance task, plant staff creates a WTF in Filemaker. Staff assigns the priority of the repair, puts a white maintenance tag on the equipment that needs repair, and enters the tag number on the WTF. If the equipment can only be repaired when the plant is in an outage, staff puts a check in the appropriate field on the WTF.
- For each extended outage (held in the spring or fall), the plant assigns an outage manager, who queries Filemaker to find outage tasks. The plant planned maintenance outages for 2006 and 2007. Under AES's team philosophy the plant assigns outage planning variously to team leaders, operators, or other staff members.

[31] GO 167, Maintenance Standard 10 – Work Management, Guideline A-Work Identification and Selection, Guideline B-Work Planning, Guideline E-Implementation and Control of Work

No one at the plant reviews and tracks all work orders in the system to make sure they are consistent and up to date, nor does the plant train employees systematically in the use of the system. The employee who set up Filemaker stated that he maintained the database as time permitted, but this was not his only or primary function at the plant. He also shows others how to use the system from time to time. According to plant team leaders, there was no formal training plan for the Filemaker system at the time of the audit.

Making coordination even more difficult was Alamitos' organization chart. Previously, Alamitos organized its staff in a matrix. Employees reported to multiple supervisors; one for his or her skill (e.g. electrician) and another based upon the generating unit they were working on. Different group leaders tracked work orders differently. In at least some groups, workers each individually took work assignments from Filemaker, and reported their plans to the group leader, rather than receiving assignments from that leader. Alamitos recently reorganized by replacing multiple supervisors with a Maintenance team leader and an Operations team leader for each pair of generating units.

The plant does not trend or otherwise analyze the number of outstanding maintenance tasks over time. The plant cannot therefore track its effectiveness in making timely repairs, nor determine whether the backlog of maintenance items is growing. Auditors saw many maintenance tags on equipment in the plant's control rooms (Figure 10).

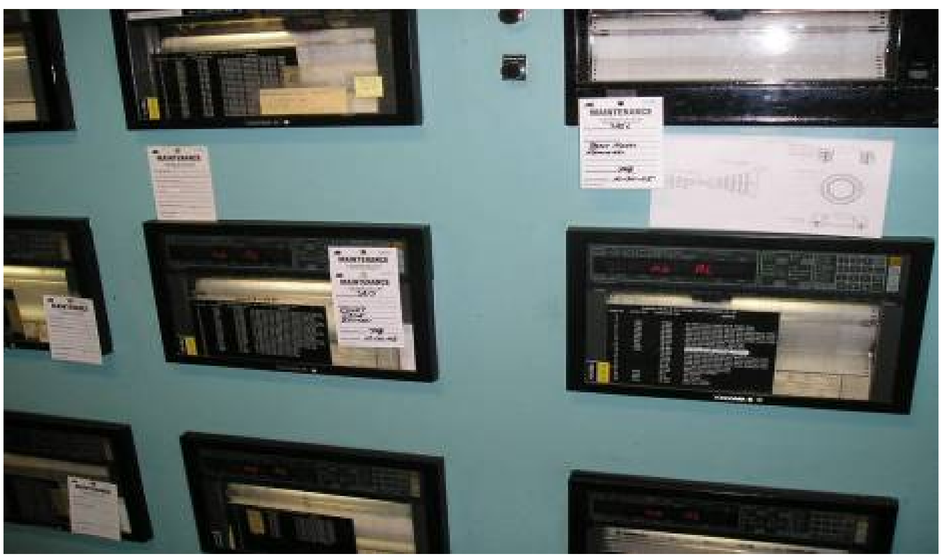

Figure 10. Chart recorders in control room need repairs.

Because the plant fails to manage the Filemaker system effectively, Filemaker entries are inconsistent and full of errors:

- Some WTFs assign work under the old matrix structure (by skill as opposed to generating unit).
- Staff enters tasks not completed (but scheduled) as "work not scheduled." The potential for confusion is obvious.
- The plant has used three different and conflicting systems to prioritize and label work tasks. Under the three different systems, a high priority item could be labeled as

priority “1”, “short”, or “A”. Various Filemaker entries contained all three. Therefore the plant had to conduct three different queries to find all high priority WTFs.
- Even the current prioritization system contains inconsistencies. Malfunctions causing violations of environmental laws (requiring a Notice of Violation to a regulatory agency) should be classified Priority A. However, auditors found some WTFs that classified these malfunctions as Priority A and other WTFs that classified these malfunctions as Priority B.
- Not all WTFs have a corresponding maintenance tag or even a tag number. For example, WTF #0102291 lacked a maintenance tag number. The team leader stated that the plant has only recently required staff to generate a tag number for every computerized form.
- Plant staff followed different conventions when numbering tags in Filemaker. Some staff assigned a leading zero to tag numbers; others did not. Auditors searched for tag 03568, and were unable to find it in Filemaker, because Filemaker showed tag number 3568 instead.
- Although a team leader stated that there should be one and only one maintenance tag for each computerized form on the Filemaker system, the system fails to maintain a one-to-one correspondence between physical work tags and computer entries, Filemaker contained multiple WTFs for tag # 1325.
- The plant has failed to assign several WTFs that must be performed during maintenance outages to particular outages, including WTFs 0400471 to 0400474 for installation of cathodic protection on the traveling screens for units 1 and 2.
- Finally, some WTFs were incomplete and some WTFs requiring outages were not marked correctly.

Filemaker’s failure to track maintenance work interferes with the plant’s operation; in particular the plant:

- Failed to repair a 480 volt ground fault alarm, contributing to a plant outage during a Stage 2 alert.
- Deferred maintenance tasks as many as five or six years in some cases.
- Deferred dozens of medium priority tasks for multiple years.
- Left many tasks shown as incomplete on Filemaker, even though plant staff believe them to be complete
- Failed to assign responsibility for safety repairs to any particular group; at least one safety repair scheduled in 2002 has not been made.

The plant failed to complete the repair of an alarm that could have shortened an outage at the plant during a statewide Stage 2 electric emergency. Unit 3 and 4’s circulating (cooling) water pumps and other equipment sit in a pit below sea level. Equipment in a similar pit serves Units 5 and 6. High water levels in either pit causes a ground fault in the respective 480 V electric system, which should activate both a visual and an audible alarm in the respective control room, alerting controllers to the situation. In December 2004, staff entered a Priority B repair order for Unit 3 and 4’s alarm. The plant failed to repair the alarm. On

July 21, 2005, a corroded circulating (cooling) water pipe burst, flooding the pit for Units 3 and 4, and putting those units out-of-service during a Stage 2 electric emergency.

This incident is particularly troubling because of a similar failure in Units 5 and 6. In March of 2005, plant staff changed valve settings and inadvertently flooded the pit for Units 5 and 6, putting those units out-of-service. The plant's analysis showed that the audible alarm malfunctioned and failed to sound; operators failed to notice the visual alarm. The operators were unaware of flooding until a contractor who happened to be on site noticed that the pit had filled with water and made a verbal report.

The plant has deferred maintenance tasks as long as five or six years in some cases. Although the plant scheduled repairs to a boiler circulation pump and a thermocouple lead, in 2000 and 2001 respectively, these repairs have not been completed.

WTF Number	Task	Date Entered
102838	Thermocouple lead	August 2001
0000321	Valve on Boiler Circulation Pump	July 2000

The following chart shows a number of other repairs the plant has delayed:

Approximate # of tasks scheduled but not completed	Year Scheduled
24	2002
12	2003
36	2004
400+	2005

As of November 3, 2005, Filemaker contained 389 WTFs for incomplete electrical repairs of medium priority. Many other tasks are shown as incomplete in Filemaker although plant staff believes them to be complete:

WTF Number	Task	Status
0205725	Repair acetylene bottle and drill in welding area	Completed but still marked as active
0205726	Assorted safety repairs in welding area	Completed but still marked as active
0301222	Destroyed hose reel	Completed but still marked as active
0500897	Leaking elevator roof	Completed but still marked as active

In at least one case, staff replaced an old WTF (#001240) with a new one, but neglected to close out the old WTF.

Because the plant has not assigned responsibility for safety repairs to any particular group, the plant failed to mark as completed at least four safety repairs scheduled in 2002. The schedule showed three repairs to acetylene bottles, for a broken valve, a broken pressure gauge, and missing fire barriers between bottles. In addition, the cord of a "magnetic drill" was frayed and needed replacement. The WTF assigned the repairs to the "safety team," leaving responsibility unclear. Further, the WTF indicated that the repairs were incomplete. Several plant employees initially stated that they believed the repair had been made. However, none were able to document the repair.

The plant corrected some of the problems during the audit visit. For example, the plant corrected the priority of various WTFs.

Outcome and Follow-up

In February 2006 the plant began to look for trends in maintenance backlogs and PM task creation. The plant intends to increase PM tasks, and to complete the PM tasks at a 90% rate while reducing repair workorder backlog. The auditor verified that the plant has been achieving these goals, currently completing 93.4% of their PM tasks on schedule. The current backlog totals 605 items, significantly fewer than at the time of the audit.

Beginning in October 2007, the plant, along with all AES plants, plans to install and use a Systems Application and Products (SAP) database to manage work at the plant. The plant reassigned a team leader as permanent liaison for the project, in order to oversee the transition, training programs, and operation of the new system. For the first few months of operation, the plant will utilize the SAP software alongside the legacy Filemaker system.

In preparation for this transition, the plant gathered and validated data from the Filemaker system. The plant began to validate data in 2006, and will use the data for the corporate-mandated switch to SAP.

Finding 6: The plant fails to chemically clean boilers despite leaks.

The plant has failed to clean chemically any of its six boilers since 2001, a potential violation of maintenance and operations standards.[32] Over time, deposits form on the boiler tubes, impeding heat flow, reducing output, and causing corrosion of the tubes. Unless the plant tracks such deposits and regularly cleans them from the tubes, the deposits corrode the tubes and cause leaks. In 2005, boiler tube leaks shut or derated various units at the plant eight times,[33] a relatively high number considering that the plant operated only 10 percent of the time. The plant cleaned Unit 1 in 2001, and has cleaned no units since that time.

Outcome and Follow-up

Tube deposit inspection reports submitted to CPSD found that boilers were "moderately dirty" and "very dirty" and recommended cleaning.[34] Alamitos states that it cleans boilers based upon tube deposit reports, however the plant has in fact not done so. Leaks continue at the plant and deficiencies remain in the plant's boiler maintenance. While the plant attributes

[32] Maintenance Standard 7 – Balance of Maintenance Approach, Guidelines B, E and L.

[33] According to data from the Generating Availability Data System, maintained by the North American Electric Reliability Council.

[34] Southern California Edison boiler tube sample reports dated March 8, 2006 for Units 2 and 4 and September 29, 2006 for Units 5 and 6.

some leaks to other causes, CPSD believes tube cleaning and proper maintenance of water chemistry are also important factors, particular in view of Finding 4 on water chemistry control. In view of the continued problems at the plant, Alamitos should develop a comprehensive boiler cleaning and maintenance program within six months of the date the California Public Utilities Commission approves this Final Audit Report, and implement the programs within one year of that date.

Since the initial audit visit and report, Alamitos's boiler tubes continue to leak, twice causing dangerous breaches of the boiler casing. In particular, Unit 2's steam tubes ruptured in August 2007, blowing out a boiler entry porthole. Again, in May 2008, a rupture caused a four-foot hole in the wall of the boiler. Such explosions could kill or seriously injure anyone walking by.

The plant contends that some or all of these failures stemmed from water turbulence near boiler chill rings. Older plants welded boiler tubes together using such boiler chill rings, otherwise known as "backing rings." Chill rings are an important issue at the plant; in fact, after the August 2007 pipe failure, Alamitos told a CPSD inspector that it would replace all of Unit 2's chill rings. CPSD has two concerns: 1) The plant has not yet replaced the chill rings, and 2) Chill rings are unlikely to be the only explanation for leaks. Boiler tubes have leaked at some distance from chill rings. Contractor reports found hydrogen damage, thick deposits, and corrosion in failed tube samples and recommended that the plant investigate other boiler tube areas for additional damage, including hydrogen damage, creep damage, overheating, and corrosion damage from carryover of pre-boiler corrosion products.[35]

Although the plant provided tube inspection reports in response to the preliminary audit report, the plant has yet to fully explain its failure to clean the boilers since 2001. As discussed above, two inspection reports recommend cleaning. The March 2006 report states that tubes had deteriorated so badly, that acid cleaning the unit would likely uncover additional leaks. In response, the plant has replaced several sections of boiler tubes. However, replacing tubes is no substitute for proper chemistry control and/or boiler cleaning; without such measures, tubes will continue to develop leaks, with attendant risks and costs. Second, the plant said it will not clean Units 5 & 6 because it controls corrosion through oxygenated water treatment. However, CPSD believes that oxygenated units require some cleaning, albeit at longer intervals, based on corrosion and deposit levels. Furthermore, the plant's own procedures require cleaning of Units 5 & 6.

[35] Riley Power metallurgical report dated September 13, 2004. Riley Power Unit 2 inspection report dated December 14, 2004. Riley Power Unit 2 metallurgical report dated February 8, 2005. Riley Power Unit 4 metallurgical report dated November 23, 2005.

Finding 7: The plant has fallen behind schedule in calibrating hydrogen detectors.

The plant has failed to calibrate detectors for hydrogen gas every three months as required by their own plan, a potential violation of maintenance and operation standards.[36] Auditors inspected two Gas Alert Max meters and found that they bore up-to-date calibration stickers; the certificates on file were also up-to date. However, the plant does not enter calibration of these meters as regular maintenance tasks in its Filemaker database. Plant records indicate that the plant has delayed calibrations by as much as five months, as shown in the table below. Failure to properly calibrate such meters could permit buildup of explosive gas in confined spaces at the plant.

Equipment Serial Number	Calibration Sheet Date	Date Next Calibration Due	Date Next Calibration Performed
L403-5682	11/15/04	2/15/05	7/13/05
L403-5682	7/13/05	10/9/05	10/27/05
1-006918	11/15/04	2/15/05	3/21/05
1-006918	3/21/05	6/19/05	10/18/05

Outcome and Follow-up

In January 2006 the plant added a quarterly PM task (PW001658) to the maintenance management system to remind plant staff to calibrate all gas alert meters. The auditor verified that the plant created this PM task, as well as another PM task (PW0604426) for a multi-gas meter used at Units 3 and 4. Records indicate that meter calibration is up to date.

Finding 8: The chemistry lab fume hood fails to function.

The fume hood ventilation system in the Unit 1 and 2 chemistry lab did not function at the time of the audit, a potential violation of maintenance and operations standards[37] that could expose employees to hazardous materials. When asked about the hood, the plant chemist replied, "we really don't need the fume hood. We don't use it." However, if the lab conducts tests involving hazardous chemicals, laboratory technicians will need a working fume hood. In addition, technicians unfamiliar with the laboratory might begin hazardous procedures in the belief that the hood was functioning. A CPSD auditor discussed the matter with the plant safety officer. The plant has an Environmental Laboratory Certification (Certificate Number: 2470), issued by the State of California, Department of Health Services for Environmental Laboratory Accreditation Program. However, this certification shows only that the laboratory may conduct certain tests and has qualified staff. It does not verify that safety equipment functions adequately.[38]

[36] Operations Standard 1 – Safety; Operations Standard 11 –Operations Facilities, Tools, and Equipment; Maintenance Standard 1 – Safety; Maintenance Standard 18 - Maintenance Facilities and Equipment.

[37] Operations Standard 1 – Safety; Operations Standard 11 –Operations Facilities, Tools, and Equipment; Maintenance Standard 1 – Safety; Maintenance Standard 18 - Maintenance Facilities and Equipment.

[38] According to conversation with George C. Kulasingam, Ph.D., Program Chief, for the Environmental Laboratory Accreditation Program with the Department of Health Services in Berkeley, California the certification of the laboratory does not address plant safety. The certificate contains only a "List of Approved Fields of Testing and Analyses" and laboratory staff qualifications.

Outcome and Follow-up

According to plant personnel the fume hood for Units 1 and 2 is no longer needed, because the mixing of chemicals for the entire plant now takes place in the chemistry laboratory at Units 3 and 4. The auditor visited the chemistry laboratory for Units 3 and 4, and found that the ventilation system for the fume hood works properly. The plant submitted a copy of the latest certification for the hood, dated June 6, 2007. The plant placed a warning sign in the disused fume hood (Figure 11).

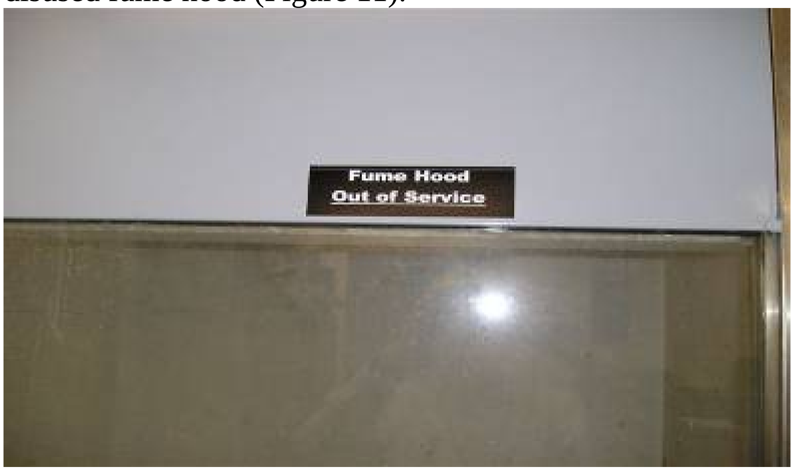

Figure 11. The plant labeled the disused fume hood.

Finding 9: The chemistry laboratory lacks an overhead drench shower.

The chemistry laboratory behind the Unit 3 and 4 control room lacked an overhead drench shower, a potential violation of maintenance and operations standards.[39] In addition, when the CPSD auditor asked about the location of the nearest overhead shower, the laboratory operator was unable to identify such a shower.

In the event an employee contacts acids or other hazardous materials, such showers can prevent or reduce resulting injuries. The laboratory's eye wash station contained minimal amounts of water and could not remove large amounts of hazardous materials. Furthermore, lack of a drench shower potentially violated OSHA standards.[40]

Outcome and Follow-up

The plant has installed a handheld shower, and plans to install a permanent drench shower.

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[39] Maintenance Standard 13 – Equipment Performance and Materiel Condition, Guidelines H and N.

[40] Occupational Safety and Health Administration (OSHA) Regulation; 1910, 1450 App. A; Subsection C.1.d, states, *"Laboratory facilities should have other safety equipment including eyewash fountains and drench showers..."*

Finding 10: The plant has failed to maintain cable trays and cables.

The plant has failed to maintain cable trays and cables throughout all units at the plant, potentially violating maintenance and operation standards.[41] A September 2005 consultant report[42] found physically overloaded trays, and deteriorating cables due to exposure to sun, rain, or high heat. The plant noted problems with cables and cable trays in its initial presentation to CPUC auditors.

Outcome and Follow-up

These cables are critical to plant performance, and, barring obvious problems, the manager is reluctant to work on them, for fear of creating more problems than they would solve. Nonetheless, the plant did perform repairs in the areas most at risk, particularly by replacing cables (WTF0602523) and adding cable trays (WTF0600820) in Units 3 and 4, which, according to a team leader, operate the most, and have the most overloaded cable trays.

The auditor toured the entire plant and, although many trays appeared full, he saw no cables dangling out of cable trays. The auditor saw no outdoor cable trays lacking covers, although most cable trays in the auxiliary bay were open. Additionally, the plant manager stated that the plant adds new cabling to new conduits rather than existing cable trays. The auditor verified that the plant recently installed turbine control cabling in new conduit. The plant added cable tray inspections to the daily unit walkdown checklist and bi-monthly maintenance inspections.

The plant has not added any reflective protection or fan to the Unit 3 cable tray which the Edison consultant characterized as being subject to excessive heat. The auditor did not find high heat levels in this location, however, after the preliminary report, wires in the Unit 3 and 4 auxiliary bay short-circuited, causing a brief outage. The plant attributed this problem to worn insulation and moisture from a steam leak in the area. The team leader stated that the plant replaced these wires, and will repair the steam leak when the unit comes offline. To ensure that cables are not overheated, the plant should include cabling in its expanded thermography program (see Finding 11).

In short, the plant agrees to inspect the cables and cable trays, fix worn cables, cease overloading trays, and install protective covers or devices as necessary. CPSD plans to review cable tray maintenance in one year.

Finding 11: The plant lacks a complete testing program for relays and circuit breakers.

Although the plant has adopted a new, uniform maintenance program for circuit breakers and relays, the program omits thermography, a potential violation of operation and maintenance standards.[43] Before 2005, teams at each unit kept track of that unit's breakers and relays on

[41] Maintenance Standard 7 - Balance of Maintenance Approach, Guidelines B, E, and L.
[42] AES Alamitos Units 1 thru 6 Cable Trays report dated September 14, 2005.
[43] Maintenance Standard 7 - Balance of Maintenance Approach, Guidelines B, E, and L.

their own schedules. In that year, the plant began a uniform predictive maintenance program throughout the plant, including regular maintenance, inspection, and tracking and record keeping. The plant plans to inspect breakers visually when the plant is off line, but does not plan to use thermography.

Routinely used at power plants and other installations during operation, thermography testing locates overheated components and connections well before they fail. Handheld thermographs display an image with different colors representing different temperatures. An inspector can quickly identify overheated components, possibly before any damage occurs, even when the plant is in full operation. The plant stated that it does not conduct thermography tests because of the dangers of opening cabinets with active electrical equipment. However, it is possible to install viewing ports in cabinets, allowing safe thermographic inspections.

Outcome and Follow-up

The plant lacked a comprehensive thermography program. The plant agrees to develop a comprehensive thermography testing program, including circuit breakers, relays, cables, and all other plant equipment subject to thermal stress. At a minimum, the comprehensive program should include corrective actions for all specific issues in the preliminary report. Further, it should include detailed and documented procedures for preventive and predictive maintenance, including what tasks the plant will perform, at what frequency, and what measurements will trigger further action.

In one year, CPSD will re-evaluate the program, and expects to see documentation of the new program, including evidence and records showing that the plant complies with the newly developed program.

Finding 12: The plant fails to schedule repairs to many miscellaneous problems found by consultant studies.

The plant failed to schedule repairs to many miscellaneous but important systems, a potential violation of maintenance and operations standards.[44] Under contract, a retired power plant manager examined the plant in detail during the summer of 2005. He had worked for 30 years for Southern California Edison, the builder and original owner of the plant. His reports identified many problems not discussed in other audit findings. The problems include:

- Malfunctioning gauges used to indicate differential seal oil pressure on the generator for Unit 2. Without working gauges, the plant could overlook loss of seal oil, resulting in damage to the generation and release of explosive hydrogen gas. This is of particular concern because the plant has not calibrated hydrogen detectors on schedule (see Finding 7)

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[44] Maintenance Standard 7 - Balance of Maintenance Approach, Guidelines B, E, and L.

- On Units 1-4, unreadable signs on the disconnects for the 66 kV bus; a potential safety hazard.
- On Units 5-6, a portion of the 4 kilovolt bus housing covered with plastic sheeting to protect it from rainwater leaks.
- Various holes in service air hoses in the plant, which are an essential part of the plant's cooling air system.

When asked to show auditors work orders to correct these problems, a team leader stated that the plant had not addressed these problems in the month since the plant received the report.

Outcome and Follow-up

With the exception of corrosion problems (see Finding 1) the plant addressed all the major recommendations of the Edison consultant report. The auditor confirmed the most critical repairs.

The plant replaced not only the seal oil gauges on the system, but also many other gauges and/or gauge windows throughout the plant. The plant completed over 200 repairs to the service-air hoses, and added PMs for the service air system. The plant repaired the leaking turbine deck and removed the plastic covering from the underlying 4 KV bus. The plant labeled piping using color-coded, ANSI-standard labels, which indicate the pipe's content and flow direction. The plant also labeled or re-labeled many electrical devices. The plant labeled critical manual valves to indicate the proper handle position during normal unit operation. The plant should address the corrosion problems, as discussed in Finding 1.

Finding 13: The plant fails to schedule or complete furnace repairs.

The plant failed to schedule or complete repairs to the furnace walls on various units, a potential violation of maintenance and operation standards.[45] For example, a February 7, 2005 report by Proline identified several hot spots on Unit 4 including multiple sources of hot gas leaks. This report did not categorize the severity of the findings. The auditor asked for documentation of corresponding repairs; the plant had none.

Outcome and Follow-up

CPSD requests that the plant 1) include furnaces in its comprehensive thermography program (see Finding 11) and 2) provide previously requested documentation that it has completed repairs to the furnace. The plant has failed to provide documentation of approximately $2 million of furnace repairs, despite repeated CPSD requests. Action on furnaces is critical; in April 2008, flames breached Unit 3's boiler casing, putting the unit out-of-service for more than three days. The plant's comprehensive thermography program should prevent recurrence of such problems.

[45] Maintenance Standard 7 - Balance of Maintenance Approach, Guidelines B, E, and L.

Finding 14: The plant fails to perform systematic root cause analysis.

The plant fails to perform systematic root cause analysis, a potential violation of maintenance an operations standards.[46] The plant lacks a written procedure for root cause analysis. As a result, the plant's process for determining when and how to perform root cause analysis is informal, inconsistent, and therefore ineffective. The plant gave auditors only two root cause analyses for the last two years, both pertaining to flooding in the Unit 3 & 4 and Unit 5 & 6 circulating (cooling) water pits. One analysis was one page, but was supplemented with a pipe thickness evaluation by a contractor (Edison ESI). The contractor found some evidence of corrosion, but neither analysis pinpointed the root cause of the corrosion. The other report was roughly two pages with no supplemental report or drawing. According to that report, plant staff changed valve settings and inadvertently flooded the pit for Units 5 and 6, damaging equipment in the pit. The report was difficult to interpret because it lacked schematics or drawings of the pipes and valves. A plant team leader stated that the plant regularly performs root cause analysis, but often on an informal basis. In practice, the plant does not consistently document such informal analysis.

Outcome and Follow-up

In Spring 2006, the plant implemented a formal root cause analysis system (PROACT by Reliability Inc). Two of the three team leaders have completed the full training, with the third team leader and two engineers scheduled for training in 2007. Using the process, the plant produced an analysis, "Improper Clearance on Unit 6 SCR Valve Installation", dated May 11, 2007. The plant prepared a written list of triggers for root cause analysis, which include safety or environmental problems, major equipment failure, or loss of revenue over $100,000.

Finding 15: The plant's program for routine inspections is inadequate.

The plant lacks procedures for routine inspections, uses deficient checklists for those inspections, and occasionally fails to document and/or perform those inspections, potentially violating maintenance and operation standards.[47] The plant lacks a written procedure for routine unit walkdowns and inspections. While plant staff use a checklist that suggests that staff should inspect the plant twice daily, that checklist lacks enough detail to identify or trend problems. Finally, staff does not always fill out the checklist, raising the possibility that they do not always conduct required rounds in the first place. Proper rounds would have detected a missing bolt in an electrical box that caused a major outage in 2004.

The plant lacks a written procedure to specify the conduct, frequency, or conduct of routine inspections. Rather staff uses a checklist for "walkdowns" with boxes for a morning and evening walkdown, indicating that the staff should inspect the plant at each shift.

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[46] Maintenance Standard 4 – Problem Resolution and Continuing Improvement, Guideline B- Problem Reporting, Root-Cause Analysis, and Corrective Actions.

[47] Operations Standard 13 – Routine Inspections

However, that checklist lacks the detail necessary for systematic inspections and follow-up. For example, the Unit 3 and 4 checklist contains only 18 separate items. Worse, it inappropriately groups “transformers, nitrogen bottles, oil levels and temps OK” as one checklist item. It’s not clear which item is faulty. It’s not clear whether a missing check means that equipment is faulty or has simply not been checked. Nor is it clear which of the many pieces of equipment is faulty. The checklist therefore lacks utility as a diagnostic or reporting tool.

Moreover, staff have missed inspections. An auditor reviewed all checklists for all units from June-August, 2005 and found a number of blank forms. For example, on June 19, 2005, none of the checkboxes for either Unit 3 or 4 are checked for either the day or night shifts. On July 24, checks are lacking for both shifts for all units. Forms from several other shifts for June, July, and August 2005 have no checkmarks.

Proper rounds would have detected a missing bolt in an electrical box that caused a major outage in 2004. Rain entered the empty bolt hole, which was above normal eye level, and shorted out control equipment in the box, shutting down Units 3 and 4 precipitously. The sudden shutdown seriously damaged turbine control machinery for those units. Both units went out of service, one for as long as nine months. One was an RMR unit.

Auditors noted multiple potential problems during a plant tour. Figure 12 shows water, which leaked, through an electrical box. Figure 13 shows fallen concrete resting on a pipe. Figure 14 shows a pipe that appears to be missing some insulation.

Figure 12. Water leaked through an electrical box.

Figure 13. Fallen concrete rests on a pipe.

Figure 14. Pipe missing insulation.

The plant's Business Plans for 2005 and 2006 both contain action items to "improve operational rounds."

<u>Outcome and Follow-up</u>

In response, the plant improved its checklists. The plant manager stated that the plant attempts to balance necessary granularity on walkdown checklists with the need for operators to see the big picture. The auditor visited the Units 1 and 2 control room and examined the updated walkdown checklists. The plant added several items to the checklists, including cable tray inspections and a reminder to check the outstanding maintenance items in the computerized system. Items needing repair are now listed at the bottom of the checklists, and the plant hangs them prominently in the control room. An operator stated that the plant management often solicits suggestions for improvements to the daily walkdown lists. The team leader stated that the plant will continue to improve the checklists where possible.

In addition, the plant implemented two new inspections. First, every two weeks, the team leaders inspect each other's units, using a detailed checklist. Second, monthly when the units are running, and quarterly when the units are not running, the plant inspects using a ten-page reliability inspection checklist. The auditor reviewed this checklist.

Finding 16: The plant fails to consistently train and test its operators.

The plant fails to consistently train and test its operators, a potential violation of maintenance and operation standards.[48] First, in 2005, the plant's training records indicate that two of the plant's twelve operators did not take the following courses: Lock-out/Tag-out, Confined Spaces, Hearing Conservation, Hot Works, Storage Batteries, Composition Gasses, Hazardous Waste Awareness, Asbestos Awareness, Lead Awareness and CPR First Aid. Second, Alamitos' new on-line training system fails to test employee knowledge and skills after course completion.

Finally, the plant's list of topics for staff training is confusing, a potential violation of operation and maintenance standards. The auditor reviewed Alamitos' "Safety Training Program and Safety Manual," which contains a list of 28 training topics. However, a spreadsheet showing the status of safety training in 2005 for each employee shows only 18 training topics. When the CPSD auditor asked about this discrepancy, Alamitos' safety coordinator stated that the table of contents lists all the safety topics that can possibly be involved with work on-site. Some training topics apply only to contractors brought on-site to do specialized work. For example, contractors are used for some activities, for example excavation, that require safety training. Contractors train their own workers off-site. The table of contents needs to explain the discrepancy.

Outcome and Follow-up
The plant adopted a new formal training program, including software from General Physics. In 2006, all plant employees completed classes in:

- operator basics (heat transfer, chemistry of combustion, fuels, phases of matter, energy, and pressure)
- pumps (centrifugal pump theories, cavitation in centrifugal pumps, and pump theories and differences)
- valves (valve theory, traps and piping, and valve types and characteristics)
- safety (bloodborne pathogen awareness, lead awareness, asbestos, safety, hazard communication, fall protection, hearing conservation)

In 2007, operators took classes in boiler and circulating (cooling) water chemistry.

The staff clarified its training matrix. Auditors reviewed the plant's "Monthly Safety Meeting Schedule 2007" and the latest training matrix. This finding is now resolved.

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[48] Operations Standard 6 – Training Support, Guideline D; Maintenance Standard 2 – Organizational Structure and Responsibilities; Maintenance Standard 6 – Training Support

VII. Audit Observations

Auditors found no apparent violations in the following areas.

Observation 1: Logbook Compliance

The CPSD auditor reviewed the plant's logbook standards compliance document. The compliance document contains a copy of the entire logbook standard from General Order 167, and directs the staff to fill out logbooks in compliance with the standard. The compliance document appears to meet the requirements of the General Order.

The CPSD auditor requested logbook entries from July 16, 2005 through July 31, 2005. The logbook and status sheet contained all of the information required by logbook standards.

Observation 2: Safety Procedures and Training

The CPSD auditor reviewed the training records of five randomly selected employees and found that the training spreadsheet for 2005 has up-to-date information, and that the individual training documents are complete and up-to-date. Employees had taken all required courses in 2005.

Observation 3: Plant Communication

The plant holds regular meetings to keep staff informed.
The plant schedules twice-weekly, early morning meeting for all employees to discuss plant activities and the outlook for the future. Management encouraged open communications (Figure 15). On the other three days of the week, the unit groups conduct unit early morning meetings to discuss more detailed unit specific matters. Before leaving work, each shift meets with the incoming shift to brief them on conditions at the plant.

Figure 15. Plant holds meetings for all staff twice weekly.

Observation 4: Balance of Maintenance and Condition-Based Maintenance Program

Although auditors detected many problems with the plant's maintenance programs, as described in Section 6 of this report, the plant employs a mix of preventive, corrective, and predictive maintenance. The plant schedules regular preventive maintenance based on the number of hours the each unit runs. The plant repairs failed equipment. The plant's Condition-Based Maintenance (CBM) program uses various sources of data to detect problems. Automatic sensors in many parts of the plant continuously collect vibration data. Staff take vibration readings on equipment that lack such sensors. Finally, the plant tests some equipment using ultrasound.

Alamitos' Business Plan states that the plant's preventive maintenance program will address:

- PUC Maintenance Standards 4, 5, 9, 12, and 13
- Maintenance and monitoring of 4KV breakers,
- Maintenance and monitoring of 480 volt breakers
- Maintenance and monitoring of the relay protection system
- Testing and documentation of the turbine DC oil system maintenance tasks (PMs)
- Testing and documentation of transformer testing cycles
- Operator training
- Maintenance training

Alamitos' Business Plan states that the plant's predictive maintenance program will:

- Address PUC Maintenance Standards 3, 5, 6, 7, and 9
- Expand the use of the thermographic cameras to monitor electrical systems
- Formalize the vibration monitoring program
- Continue quarterly assessment of critical equipment
- Continue to improve operational rounds
- Standardize PMs
- Create and implement monitoring and audits process
- Implement formal root cause analysis
- Plant risk assessment

The auditor asked for more information on the plant's Condition-Based Maintenance Program (CBM). The plant uses vibration analysis, oil analysis, thermography, electrical motor testing, performance testing, and length of run-time to determine the likely time to failure of each machine.

The plant classifies each unit's critical equipment as part of one of the plant's major systems, including condensate, feedwater, boiler, turbine/generator, circulating (cooling) water, and balance of plant. The plant classifies each piece of critical equipment by age (3 is oldest, 1 is newest) and by risk (10 for highest risk, 1 for lowest risk). A risk factor rating of equipment uses numbers 1 to 10, with 10 being the highest risk. Quarterly, the plant prepares a matrix, which identifies the condition and risk of failure for each piece of major equipment at the plant. The most recent matrix lists at highest risk of failure:

- Unit 1 East Boiler Feedpump
- Unit 3 Bearing Cooling Water Heat Exchanger
- Unit 5 Center Condensate Pump
- Unit 6 East SCR Blower Fan Motor

The CPSD auditor requested records showing that plant had repaired or scheduled repairs on the above the items. The plant presented WTF documents (see Finding 5 for a description of WTF) showing scheduling and completion of this work except for repair of the boiler feed pump, which had been scheduled but not completed.

The plant's Business Plans for 2005 and 2006 identify objectives for the upcoming year, as well as measures of success. Objectives included reducing the plant's EFOR rate, increasing the plant's commercial availability and reducing unplanned repairs.

Observation 5: General Document Management

Although many plant drawings are over 25 years old, a cursory review of documents by the CPSD auditor did not reveal any major problems with the document control system. The CPSD auditor reviewed five plant drawings at random for Units 1 and 2. The drawings are all over 30 years old and the auditor cannot state whether or not they represent the as-built configuration of the unit. However, the documents did not have any stray marks or drawing, and the documents had a revision checklist at the bottom. The drawings reviewed were the following:

Drawing Number	Description
597417-14	One line drawing, 220 kV switchyard
71889	P & I Drawing, Compressed Air
71891-5	P & I Drawing, Cooling Water System
71891-2	P & I Drawing, Feedwater and Condensate System
71891-4	P & I Drawing, Service Water System

Observation 6: Maintenance Tags

Plant staff places one of three types of maintenance tags on equipment in order to indicate the equipment's status. White tags indicate that repairs or maintenance are required on a piece of equipment. Yellow tags indicate that a piece of equipment is either permanently or temporarily out of service. Part of the tag-out safety procedure, red tags indicate that plant staff is working on the equipment. Plant staff are supposed to record all maintenance tags in the Filemaker database. Each Filemaker record indicates the tag type.

CPSD auditors checked two of each type of tag on Units 5 and 6 and verified that the information from the tags was recorded correctly in the Filemaker database. However, auditors found a number of problems with the plant's implementation of the database (see Finding 5).

Type of Tag	WTF or Tag Number	Work Involved
Active Clearance (Red)	Tag # 07304	U5 Fan motor
Active Clearance (Red)	Tag # 07327	U5 Forced draft fan 5N
Out of Service (Yellow)	Tag # 00217	#5 Intake hoist
Out of Service (Yellow)	Tab # 00218	#6 Intake hoist
Maintenance (White)	0504175	Manual crossover
Maintenance (White)	0401271	Ammonia recirculation

Observation 7: Housekeeping and Space Heater Usage

With some exceptions, such as the concrete shown in Figure 13, the auditors observed the plant to be clean and orderly during the on-site visit (see Figure 16). Staff use a housekeeping checklist that the plant manager reviews and signs weekly. The auditor reviewed and verified completed housekeeping checklists for July 2005. Space heaters ran in several plant locations to keep important equipment dry. During a plant tour, two CPSD auditors noted that team leaders collected rubbish.

Figure 16. Plant appears orderly and clean.

Observation 8: Plant Security and Labeling of Plant Equipment

The plant places labels on most plant components, including roughly 80% of the major pieces of equipment in the auxiliary bay and other some other areas of the plant. Each label clearly indicates the function of that piece of equipment. Additionally, the plant labels many pipes to indicate what type of fluid or gas they contain. Large labels on the units' turbines are visible from the air. These labels help repair crews diagnose and correct equipment problems. In an emergency, the labels should also help orient fire, police, or other responders.

Auditors observed clearance tags as well as warning and information signs and throughout the plant (Figure 17). At the main gate, a safety sign reminds workers that safety is a priority, and lists the number of days that the plant has been free of accidents. The auditor noted that although plant records show two injuries during 2005, the sign shows 2137 "safe days worked". The plant responded that the sign refers only to lost-time accidents.

Figure 17. Auditors saw warning signs and equipment clearance tags throughout the plant.

For security, the plant has a manned main entrance. Moveable concrete barriers reinforce entrance blockades during large public events.

Observation 9: High Impact, Low Probability Event Program (HILP)

The plant has instituted a "High Impact, Low Probability (HILP)" program. This program is designed to help prevent problems that would be very unlikely but might have catastrophic consequences financially, or in safety or availability. The HILP program consists of developing action plans and measuring them against defined standards. Many of the standards the plant has chosen to use for the HILP program are very similar to the GO167 maintenance standards.

Observation 10: Spare Parts and Warehousing

The unit 5 and 6 team leader explained that the plant uses multiple systems to track and order spare parts.

An external auditor checks inventory annually. The plant controls inventory through the MainStar Computerized Material Management System. The plant's organization chart shows three employees dedicated to the ordering and control of spare parts for the plant. The plant reviewed its inventory on October 31, 2005.

When it sold the plant to AES, Southern California Edison left many large spare parts at the plant. The CPSD auditor saw a spare rotor for a steam driven boiler feedpump for units 5 and 6, a spare boiler circulation pump for units 3 and 4, and a spare main transformer.

The team leader explained that the plant orders other critical spares. The CPSD auditor saw numerous smaller pumps and motors that appeared to be new. A large amount of critical spare stock is stored in bins, which travel on computerized carousels. The plant houses an extensive supply of boiler tube material that is used by all the AES plants in Southern California.

Both the electrical and mechanical shops contain ample spare parts. The mechanical shop locks its stockroom when not in use. A contractor, Grainger, replenishes mechanical stock weekly. The electrical stock comprises bins of lugs and connectors, which fill ten shelves, each about 30 feet in length. Another contractor, Wesco, replenishes electrical stock weekly. All the stock in the warehouse bears a bar code that also appears on the bin holding the stock.

Observation 11: Calibration of Electrical Equipment

The auditor asked a plant electrician to explain how the plant maintains and calibrates electrical test equipment. The electrician in charge of calibration explained that different equipment was tracked in different ways, as explained below.

The auditor concentrated on the calibration procedures for Gas Alert Max meters. Gas Alert Max meters detect the presence of hydrogen gas, which can explode in confined spaces. The auditor verified up-to-date calibration stickers on two Gas Alert Max meters (S/N 1-000918 and S/N 3-002765). However, although calibration of these meters is currently up to date, the calibration of these meters is not entered into the computerized preventive maintenance database, as discussed in Finding 7 of this report. As discussed in this finding, calibration of these meters has fallen behind schedule from time to time.

The auditor then performed a cursory review of the calibration procedures for other electrical test equipment. An offsite vendor calibrates “hotsticks” (voltage resistant poles used for attaching grounds), and electrician’s insulated gloves. Each electrician is responsible for submitting his or her own gloves and hotsticks for calibration. The electrician in charge tracks calibration information for the gloves and hotsticks in an Excel spreadsheet. The auditor did not verify that the plant had calibrated any particular items.

The plant does not calibrate meters regularly because the plant uses them only for ballpark measurements where accuracy is not critical. The electricians send obviously malfunctioning meters to Wilmington Instruments for repair and calibration. The auditor examined a calibration record for a vacuum meter (item #49330) that the plant sent to Wilmington Instruments.

The plant’s meggers contain self-calibration programs. The electrician in charge of calibration demonstrated the self-calibration program of a Model BM25 megger to the CPSD auditor.

Observation 12: Engineering Support

The Station Performance Engineer provides engineering support at the plant. He stated that his work is not directly associated with the predictive, preventive, or corrective maintenance programs. Rather the plant considers him a consultant. His main responsibilities include tracking and providing advice on plant performance, fuel savings, heat rate, reliability and risk assessment, and analyzing data from Ultrasonic Tests. Using a software package called Plant Information (PI); he designed computer screens which allow him to monitor all plant operations data in real-time. He and the control-room operators see the same data simultaneously. Using real time-data, he created ideal heat curves for the entire plant, referenced in the plant's contract with Williams, Inc (a broker that sells the plant's electricity).

Observation 13: Lock Out/Tag Out (LOTO) Procedures

The plant uses three different kinds of authorizations: a Clearance, a Permission, and an Approval.

When a qualified worker needs to work on hazardous pieces of equipment, he or she requests a "clearance" to assure that the plant deactivates, de-energizes, depressurizes, and/or drains the equipment in a prescribed manner to make the work safe. The plant issues a numbered red clearance tag with several detachable sections also displaying the tag's number. The work supervisor for that task removes and carries a section of the tag with him or her, and gives another copy of the tag to the worker. The supervisor attaches smaller removable sections to each piece of equipment. The plant enters the tag number and a description of the work activity in the control room log as well as the corresponding computerized Work Tracking Form (WTF) in Filemaker.

If a worker repairs equipment that remains in service, he or she requests a "Permission." The work supervisor attaches a numbered red clearance tag stamped "Permission" to the equipment. The plant enters the permission in the control room log (but not in Filemaker). For less hazardous work, such as diagnostic checks, equipment testing and calibration, and general maintenance activity, the worker requests an unnumbered "Approval." The plant enters approvals in the control room log (but not in Filemaker).

Observation 14: General Regulatory Compliance

The plant assigns an engineer to review compliance with environmental and safety regulations. The auditor verified that the plant maintains required compliance documents, as follows:

- The "Certification Report for AES Southland" describes how the plant intends to comply with each of the GO 167 maintenance standards.

- The Spill Prevention and Control Countermeasures Plan (SPPC), which the plant last reviewed and updated in July 2003 includes the names and addresses of several cleanup contractors, including ANCON Marine, and NRC Environmental. Section G of this plan requires that the plant inspect its hazardous waste containers weekly, using a specified inspection form. The auditor requested and received the completed form for the first week of August 2005.

- The auditor reviewed compliance documents for the Resource Conservation and Recovery Act (RCRA), and found a completed form for every day of August 2005. The RCRA reports are disposal records for hazardous wastes.

- The CPSD auditor also found that the oil storage area in the auxiliary bay of Units 1 and 2 was clean and organized, with adequate secondary containment. The plant had placed absorbent cloths on all spills of hazardous materials, many of which were located in the unit's auxiliary bays.

- The auditor reviewed the Unit 2's Relative Accuracy Test Audit (RATA) reports for November 24, 2004. The tests verify the accuracy of the plant's Continuous Emissions Monitoring System (CEMS). The CPSD auditor also checked the air emissions permit, issued on January 1, 2005, by the South Coast Air Quality Management District (SCAQMD).

Observation 15: Lube Oil System Maintenance and Operations

The plant uses several documents and processes to control and record the operation and maintenance of the lube oil system. The documents and processes used by the plant include the following:

Distributed Control System (DCS) Monitoring of Lube Oil System
The CPSD auditor verified that there are several oil related alarms on the DCS list, including oil pressure, oil trips, oil level, oil temp, and oil pump operational alarms.

Walkdown Checklist for Lube Oil System
The CPSD auditor verified the unit walkdown checklists contain checks for the following lube oil related items:

- Bowser filter check
- Oil pump and oil sump check
- DC Battery check

Except as noted in Finding 15 of this report, the checklists examined by the CPSD auditor for these items were complete, indicating the work had been performed.

Startup Procedures for Lube Oil System
The CPSD auditor checked startup procedures for units 1, 2, 3 and 4. These procedures included tests for the following items:

- Check lube oil reservoir normal and vapor extractor running
- Check bowser filter in service and vent fan running
- Check lube oil temp at 90 degrees
- Check DC emergency oil pump available for use
- Check turbine lube oil pressure greater than 10 psig

The CPSD auditor did not examine a completed start-up checklist.

Preventive Maintenance Operations for Lube Oil System in Filemaker
The Filemaker database contains preventive maintenance (PM) tasks and WTFs for checking the bowser filters and turbo-toc filters, as well as testing the lube oil in all the units. The

CPSD auditor verified that the Filemaker system had generated up-to-date WTFs for these PMs, and that plant staff had signed the WTFs off as completed.

Observation 16: Plant Availability Reporting

The plant's logbooks are consistent with the plant's availability reports to CAISO and NERC. Although the Preliminary Audit report found some discrepancies, auditors resolved these discrepancies on further examination.

Unit	Date	GADS data	Logbook Entry	SLIC data	Discrepancies
3	10-22-04	Start time – 7:00, Type-U1, Cause Code – 4280, Hours – 233.00, MW loss – 0	NO LOG ENTRY	NO SLIC ENTRY	None
4	10-22-04	Start time – 7:00, Type-U1, Cause Code – 4280, Hours – 233.00, MW loss – 0	NO LOG ENTRY	NO SLIC ENTRY	None
4	11-01-04	Start time – 00:00, Type- U1, Cause Code – 3621, Hours – 720.00, MW loss – 0	NO LOG ENTRY	NO SLIC ENTRY	None
5	9-01-04	Start time – 00:00, Type- RS, Cause Code – 0000, Hours – 155.00, MW loss – 0	NO LOG ENTRY	NO SLIC ENTRY	None
5	9-07-04	Start time – 11:00, Type- SF, Cause Code – 0380, Hours – 2.98, MW loss – 0	NO LOG ENTRY	NO SLIC ENTRY	None
5	12-14-04	Start time – 10:01, Type- D1, Cause Code – 3310, Hours – 249.98, MW loss – 15	Williams requests a schedule deviation on Unit 5 to a load of 466 MWs beginning immediately. Current load is 481mw's	NO SLIC ENTRY	None