State of California
Division of Occupational Safety and Health

Investigation Summary

Reporting ID	Investigation Summary Number	OSHA-36 Number	OSHA-36 Establishment Name
0950621	**202489431**	**102514833**	**CA Water Resources**
Event Date	**07/22/09**	Event Time	**07:30 am**
Type of Event	**hit by tools and debris at over 100 mph**		

Inspection Number/ Establishment Name	**313228637** **CA Water Resources**
Injured/Deceased Name	[redacted]
Sex:	**M. Male**
Age:	**37**
Injury:	**B. Hospitalized**
Nature:	**12 Fracture**
Part of Body:	**04 Body system**
Source of Injury:	**02 Air pressure**
Event Type:	**01 Struck by**
Environmental Factor:	**05 Flying object action**
Human Factor:	**09 Safety devices removed or inoperative**
Task:	**A Regularly Assigned**
Substance Code:	
Occupational Code	**575 - ELECTRICIANS**

ENTERED

Abstract:

The accident takes place when 5 employees are directed to go to the River Valve Chamber of the Hyatt Power Facility inside of Oroville Dam. The employees are directed to open the river valves to 100% on 7/22/09. When the valves were opened to 85% the Break-Away wall was vacuumed/pulled away and down stream into the 35 foot river diversion tunnel. The vacuum eliminated the lights and sucked any loose unattached materials or equipment in the access areas above the RVC toward the RVC. The vacuum knocked 3 (#1,2 and 3) off of their feet and toward the tunnel. The vacuum pulled 2 employees over the edge of the RVC concrete platform. Employee #4 was hanging over the end of the valve holding on to bent and twisted the metal railing. Employee #5 was hanging over the edge of the RVC concrete platform holding on to the bent rail and was struck by various tools and equipment that was located in the access tunnel to the RVC.

When the river valves were installed in the 1960's the US Bureau of Reclamation performed modeling of the River Valve Operation and designed the Energy Dispersion rings to be used in conjunction with the valves in the river valve tunnel. The energy dispersion ring was damaged in 1968 and DWR contracted with UC Davis in 1993 to perform a study on the use of the cone valves and the need for the energy dispersion ring. The UC Davis report documents the turbulence and energy created in the tunnel with and without the energy dispersion ring and concludes that operation of the river valves in the tunnel should not be done or severely limited with out the energy dispersion ring. DWR was aware of these studies and had copies and a video of the actual test.

Employee #5 was seriously injured with head trauma, broken leg, broken arm and multiple bruises and cuts. He was hospitalized for 4 days.

CSHO Signature:	[redacted]	Date:	1/15/10

DM Signature:	[redacted]	Date:	1/20/10
RM Signature:		Date:	

STATE OF CALIFORNIA
DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

* |__| Fatality

* W.C. Carrier _____

NARRATIVE SUMMARY

Establishment Name	CA Water Resources	Inspection Number	313228637
Management Contacted	Pete Scheele	Title	Chief-Field Division Hyatt

Information on Injured

Covered by Workers' Compensation Yes___ No___

Name, Address and Phone Number	Occupation
[redacted]	Electrician

Use additional forms(s) as needed.

Witness Name(s) and Title

*Check box preceding name if confidentiality is given.

*	Names and Title(s)	Address	Phone No.	Signed Statement? **YES** **NO**
	[redacted] Student Assistant-[redacted] Inside of RVC when accident occurred.	[redacted]	[redacted]	Recorded Interview
	[redacted] Apprentice Operator Inside of RVC when accident occurred.	[redacted]	[redacted]	Recorded Interview
	[redacted] HEP	[redacted]	[redacted]	Written Statement
	[redacted] Mechanical Engineer Inside of RVC when accident occurred	[redacted]	[redacted]	Recorded Interview

Summary

INTRODUCTION

The accident took place on 7/22/09 at approximately 7:30 AM in the Hyatt Power Facility (Oroville Dam) 5 employees were directed to open the river valves in the river valve chamber. Opening of these valves created a vacuum and caused a break-away wall in the chamber to be pulled away and detached exposing the employees to winds that pushed them in the direction of the water flow (with wall).

ACCIDENT DESCRIPTION

The accident takes place when 5 employees are directed to go to the River Valve Chamber of the Hyatt Power Facility inside of Oroville Dam. The employees are directed to open the river valves to 100% on 7/22/09. When the valves were opened to 85% the Break-Away wall was vacuumed/pulled away and down stream into the 35 foot river diversion tunnel. The vacuum eliminated the lights and sucked any loose unattached materials or equipment in the access areas above the RVC toward the RVC. The vacuum knocked 3 (#1,2 and 3) off of their feet and toward the tunnel. The vacuum pulled 2 employees over the edge of the RVC concrete platform. Employee #4 was hanging over the end of the valve holding on to bent and twisted the metal railing. Employee #5 was hanging over the edge of the RVC concrete platform holding on to the bent rail and was struck by various tools and equipment that was located in the access tunnel to the RVC.

Employees 1,2, and 3 were able to close the spherical valve #1 and were having trouble closing spherical valve #2 but it was eventually closed and the vacuum was turned off.

Employee #5 was seriously injured with head trauma, broken leg, broken arm and multiple bruises and cuts. He was hospitalized for 4 days.

FINDINGS

-The River Valve System includes the river dispersion tunnel, river valve chamber, river valve tunnel ventilation tunnels, access tunnel to rvc and the equipment and machinery in the river valve chamber (vacuum sensors, motors, spherical valves, cones valves, break away door, communication system, oil alarms, water level alarms and associated electrical connections).

-The energy dispersion ring was removed from the river valve system in April of 2009. This is a critical safety device in the operation of the river valves. It was not replaced. DWR stated (TB) that the ring was not replaced because DWR did not have the time with the up coming season.

-Cross section (Model) of river valve area showing deflector ring/energy dissipation ring (1963 Bureau of Reclamation Study) was an integral part of the engineered system involving the river valves and 35 diameter diversion tunnel.

-Department of Dam Safety was not consulted and did not approve the removal of the energy dispersion ring. When DWR makes any changes to the Dam they must get approval from this group and they did not get approval. No party, body, group or department reviewed, analyzed or inspected the river valve system to determine the hazards created by removal of the energy dispersion ring.

- The employees in the River Valve Chamber during operation of the river valves have limited access as they are in the ventilation of the discharge volume exposed to air flow of over 100 mph.

-DWR wanted to determine the destructive effects of removal of the energy dispersion ring by opening the river valves to 100%.

-The Howell-Bunger Valves (cone valves) have historically failed when operated at 100%.

-DWR had not evidence of ever opening the river valves to 100% during the life of the system, but decided to operate them in this capacity without the energy dispersion ring.

-Opening of both of the river valves to 100% is a flow rate of 5400 cubic feet per second.

-Employees expressed safety concerns (see interview notes and recordings) with operation of the River Valves to 100% because this is not the way they systems was engineered or designed to be used.

-Modeling studies done when dam was constructed and in 1993 by UC Davis (see file and dvd)). Both concluded that the operation of the river valves in the tunnel should not be done or severely limited with out the energy dispersion ring. DWR was aware of these studies and had copies and a video of the actual test. The tests and studies and original engineered design were ignored and the operation of the river valves was approved.

-When the energy dispersion ring was removed DWR failed to evaluate the river valve chamber and potential hazards employees would be exposed to while in the chamber activating the river valves.

-The River Valve Chamber break-away wall was never inspected for integrity or safety for over 40 years.

-The vacuum alarm on the break-away wall in the RVC Chamber was disconnected and not in operation when valves were operated and DWR stated they have never inspected or maintained this alarm.

-The access was limited during the operation of the river valves. Employees could not escape the chamber due to the hurricane like winds. Terry Becker, Civil Engineering Branch Chief stated that the winds calculated to be in excess of 100 mph. Employees in the RVC were blown off of their feet and into walls and down stream.

-Corroded bolts were identified that were intended to secure the break-away wall (23 failed before accident-corroded and no evidence of shearing). Also, foam sealant had been placed in the past by DWR employees around door to keep water out - foam was located in area where bolts were corroded. This indicates knowledge of corrosion and failure of the bolts and seal of the door.

-The Hyatt Plant Operating Supervisor was in the control room when the accident occurred and noticed the liquid level alarm rising above normal levels (18 feet) near the River Valve Chamber (RVC). The Operator attempted to contact the employees in the RVC via phone (phone in the room). The noise in the room was so load the employees could not hear the phone and be warned of the hazards.

-Air flow in the entire dam complex changed and vacuum/suction was created. Metal doors were ripped from their hinges due to vacuum created. Doors were located above river valve chamber in another tunnel, hundreds of feet away.

-Employees in the Hyatt Plant attempted to enter the access tunnels during the accident to get to the RVC and the vacuum that was created would not allow them to stand and walk to enter at the entrance.

-The cone valve is used in the tunnel which is confined and demands high amounts of air at high velocities during discharge. The American Society of Mechanical Engineers Hydro Power Technical Committee the Hydraulic Structures 3rd edition states that this type of valve (fixed-cone dispersion valve should not be used or set to discharge into a confined space.

CONCLUSION

DWR contracted with the University of California Davis to perform a study on the use of the cone valves and the need for the energy dispersion ring. DWR failed to follow the recommendations of this report that the flow should be limited without the energy dispersion ring in place as originally designed. DWR conducted a destructive test by operating the cone valves at 100%. A destruction test should never be done in this manner. The valves were rated at 2700 CFS with the energy dispersion ring and after the removal of the energy dispersion ring the valves should have been de-rated to a lower flow rate. The test to de-rate the valves should have been done in very small increments; this is industry standard and good engineering practice. The cone valves were used and operated in a manner where the speed (flow) of the water thru the valves created a vacuum in the river valve system that endangered employees and causes serious injuries.

REGULATORY

Cit. 1, Item 1: 3220 (e)(2)(C): General: Failed to train employees on changes to Emergency Action Plan
Cit 2, Item 1: 3203 (a)(4)(B): SERIOUS ACCIDENT RELATED: Failed to inspect River Valve Chamber and operation of RVC system after modifications.
Cit 3, Item 1: 3203 (a)(7)(D): SERIOUS: Failed to train employees after new hazards introduced into workplace (river valve chamber).
Cit 4, Item 1: 3328 (a): SERIOUS-ACCIDENT RELATED-WILLFUL: The river valves in the valves were operated under conditions where the speed of water being released created stresses and loads (vacuum pressure) that exposed the employees to winds that endangered employees.
Cit 5, Item 1: 3328 (g): SERIOUS- ACCIDENT RELATED: (g) Machinery and equipment in service shall be maintained in a safe operating condition (vacuum alarm disconnected and bolts securing break-away wall corroded).
Cit 6, Item 1: 5157 (c)(1): SERIOUS-: Employer failed to evaluate workplace of RVC to determine that it was a permit required space that was created after removal of energy dispersion ring and operation of valves.

Use additional sheet(s) as needed.

			Date
Prepared by:	CSE, IH	[redacted]	1/15/10
Reviewed by:	DM/SR. IH	[redacted]	1-19-10
	Regional Manager		