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 FACIL: 50-275 Diablo Canyon Nuclear Power Plant, Unit 1, Pacific Ga    05000275  
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 RECIP. NAME    RECIPIENT AFFILIATION

SUBJECT: LER 93-005-01: on 891029, discovered three medium voltage cable failures due to chemical degradation & unknown causes. Established preventive maint program for sump pumps & drains. W/931004 ltr.

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Gregory M. Rueger  
Senior Vice President and  
General Manager  
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October 4, 1993

PG&E Letter No. DCL-93-233

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555

Re: Docket No. 50-275, OL-DPR-80  
Docket No. 50-323, OL-DPR-82  
Diablo Canyon Units 1 and 2  
Licensee Event Report 1-93-005-01  
Medium Voltage Cable Failures Due to  
Chemical Degradation and Unknown Causes

Gentlemen:

Pursuant to Item 19 of Supplement 1 to NUREG-1022, PG&E is submitting the enclosed revision to voluntary Licensee Event Report 1-93-005 regarding the failure of certain medium voltage 4kV and 12kV cables. This revision is being submitted to update the root cause and corrective actions of these events and to make minor editorial changes. Revision bars are included to indicate the changes. These events did not affect the health and safety of the public.

Sincerely,

  
Gregory M. Rueger

cc: Bobby H. Faulkenberry  
Ann P. Hodgdon  
Mary H. Miller  
Sheri R. Peterson  
CPUC  
Diablo Distribution  
INPO

DC1-92-EM-N054  
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I. Plant Conditions

Units 1 and 2 have been in various modes and at various power levels.

II. Description of Event

A. Summary:

Diablo Canyon Power Plant (DCPP) has experienced three 4kV and two 12kV circuit cable (EA)(CBL) failures. These failures have occurred only in underground duct bank conduits (FA)(DUCT)(CND) between the turbine building (NM) and the intake structure (NN) (see Figure 1). Both 12kV cable failures occurred on Unit 1 between the first pull box outside the turbine building and the next pull box toward the discharge structure elevation.

The subject cables were manufactured by Okonite in 1972, and are insulated with black ethylene-propylene-rubber (EPR) and jacketed with neoprene. The cables were installed at DCPP in 1973 and 1974. The cable circuits were then energized intermittently until 1984, when the circuits were then placed into service.

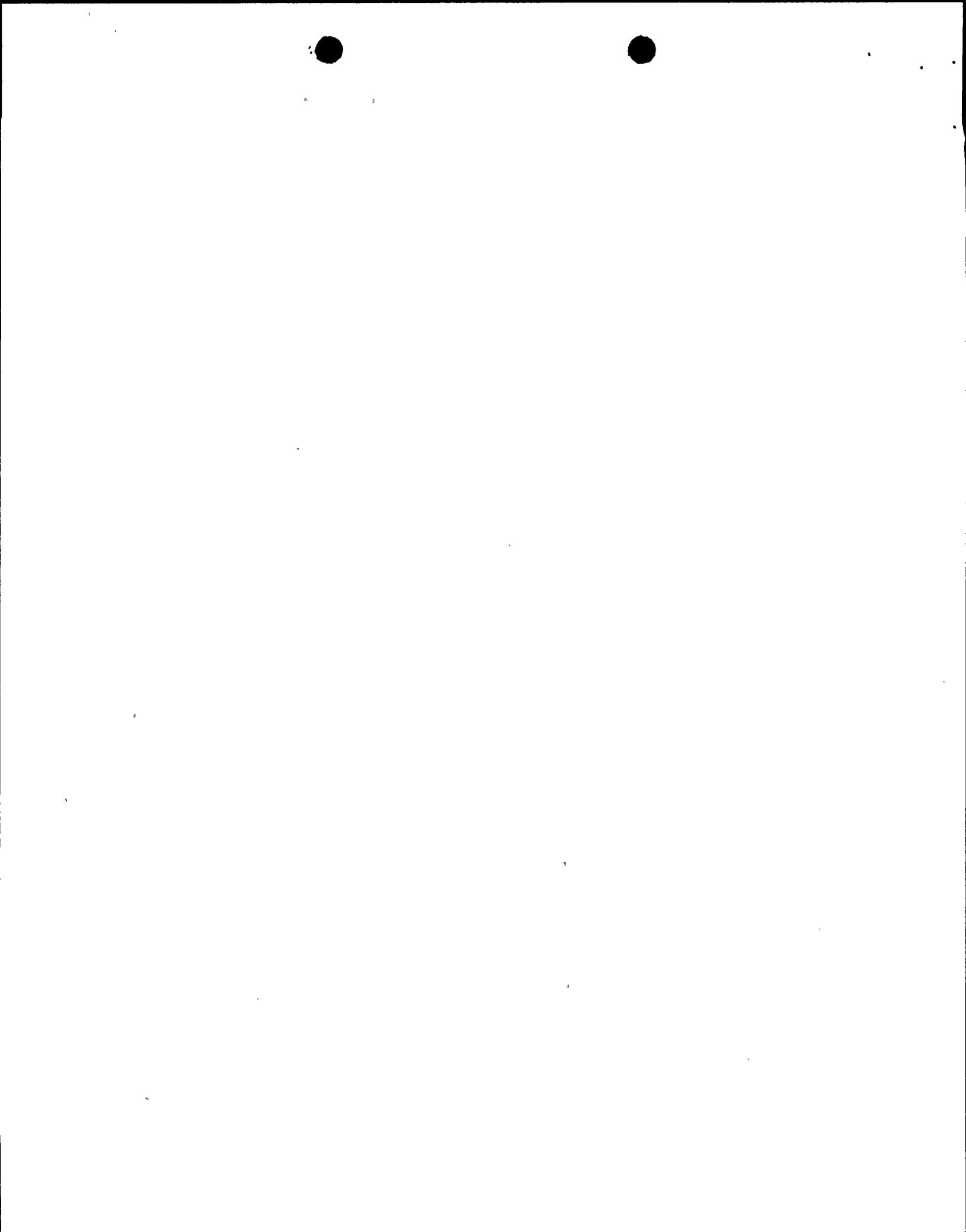
Laboratory analyses have established that the 12kV cable failure mechanism is chemical attack. No identified root cause has been found for the 4kV cable failures. However, laboratory analysis has established that the contaminants found in the 12kV cable jacket and shield are not present in the 4kV cables. PG&E concludes that the 4kV and 12kV cable failures were caused by different mechanisms. In addition, laboratory analysis has established that the 4kV cable failures were not caused by manufacturing defects, installation damage, moisture intrusion, chemical attack, thermal aging, or maintenance testing.

B. Background:

Cable Construction

The 4kV cables are rated for up to 5kV applications and the 12kV cables are rated for up to 15kV applications.

The cable construction is similar for both the 4kV and 12kV cables. The cables are a shielded single-conductor cable design and are constructed in concentric layers (see Figure 2). There are four cable layers of interest for this LER: (1) the insulation (EA)(CBL)(INS) layer, which is approximately 115 mils of black EPR for the 4kV cables and approximately 220 mils of black EPR for the 12kV cables; (2) the tinned copper shield tape, which acts to equalize the electrical stress; (3) the wax coated synthetic binder tape, which holds the copper shield against the cable, thereby allowing the outer jacket to



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be extruded over the cable during manufacture; and (4) the outside layer, which is a neoprene jacket. The function of the outer neoprene jacket is to protect the cable during installation (impact and abrasion resistance) and to act as a physical barrier between the outside environment and the shield once the cable is installed. The cable jackets are not bonded to the cable shield or insulation layers.

### Duct Bank Construction

The 4kV feeders consist of three separate single-conductor cables (one for each phase), routed in a single conduit (one circuit). The 12kV motor-driven circulating water pump (CWP) (KE)(MO)(P) feeders consist of six separate single-conductor cables (two for each phase), routed as two separate three phase circuits in two single side-by-side conduits (two circuits).

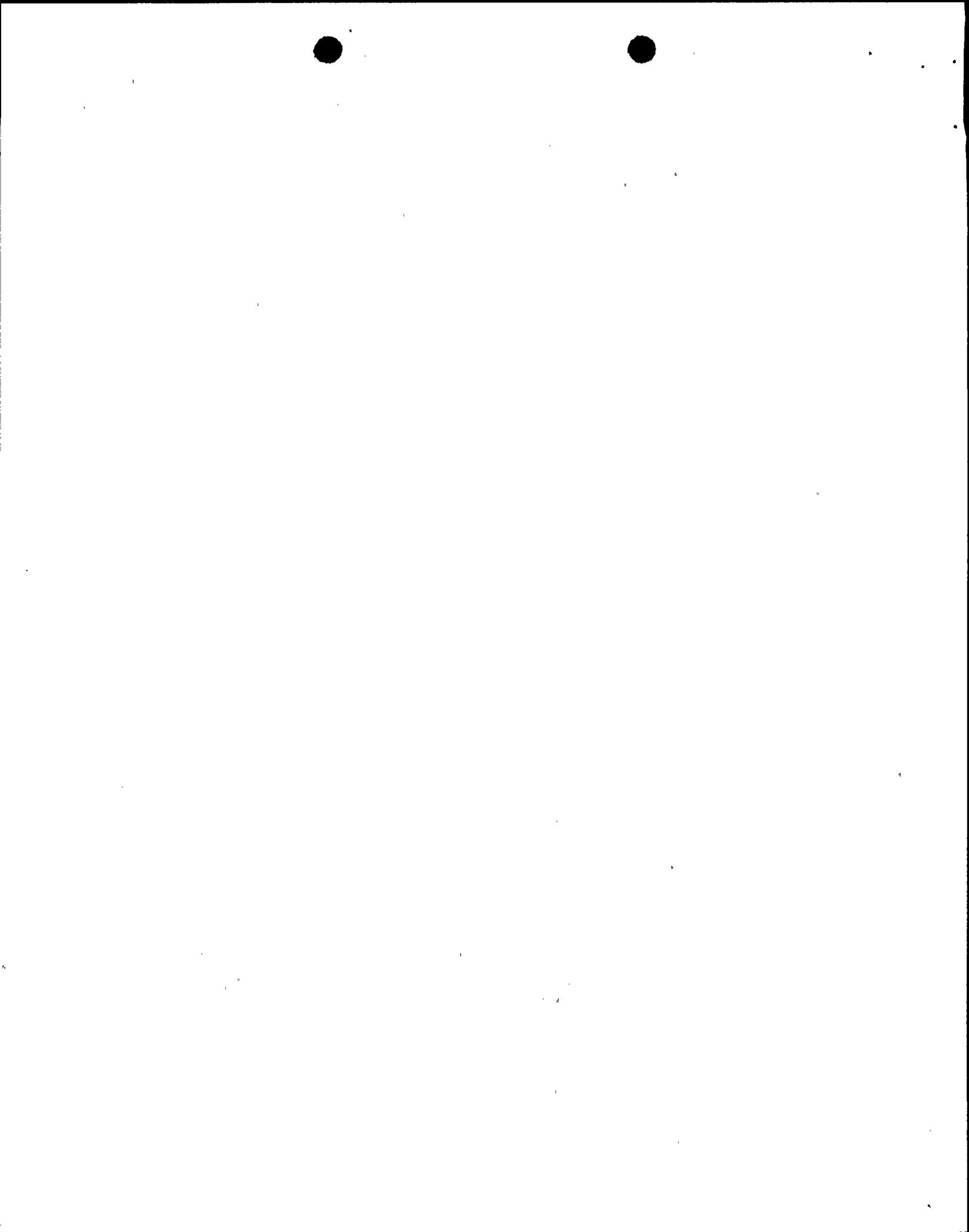
The subject cables are routed in two separate sets of duct bank conduits, one for each unit, between the turbine building and the intake structure. Concrete vaults are located at various intervals to serve as pull boxes for the circuits. These duct bank conduits are directly buried in sand and are covered for their entire length by a six-inch thick concrete cap. The duct bank conduits include 12kV, 4kV, and 480V (CBL4) power cables, 120V ac control cables (EF)(CBL3), 125V dc control cables (EJ)(CBL3), and instrument cables (EF)(CBL1).

The pull boxes immediately outside of the turbine building have drains (DRN), which are routed to common sump vaults (manholes) (FA)(PBX) for Units 1 and 2. These manholes are equipped with automatic submersible Class II sump pumps (PBX)(P).

The Unit 1 and Unit 2 trenches are similar, except that the Unit 1 duct bank rises to cross over the circulating water discharge tunnel and then slopes downhill towards the intake structure. This design makes the Unit 1 section of cable conduits near the turbine building susceptible to submergence if the pull box sump pumps are not functional and if the water within the pull boxes rises above the conduit openings.

### Cable Testing

In accordance with applicable industry standards, DCPD performs direct-current, high-potential testing (hi-pot testing) as a maintenance activity each refueling outage. Normal practice for hi-pot testing of DCPD 4kV motors (MO) is to hi-pot the motors from the switchgear (SWGR) end of the circuit, through associated cables and motor terminations. The normal hi-pot test voltage level used at DCPD for 4kV motors is 10.5 kV dc.



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The 12kV motors, due to hi-pot test equipment limitations, are hi-pot tested locally at the motor with the cables disconnected. The cables are hi-pot tested separately from the motor. The maximum voltage level used for the in-service 12kV cables is 28 kV dc.

As confirmed by discussion with the vendor, the test levels currently used by DCPD are appropriate and do not cause any cable damage. PG&E intends to continue hi-pot testing for the 4kV and 12kV affected circuits during each refueling outage.

C. Event Description:

4kV Cable Failures

On October 29, 1989, ground current alarms (EA)(GI)(IA) associated with the Unit 2 Auxiliary Saltwater (ASW) Pump (BA)(MO)(P) 2-2 annunciated twice and immediately cleared both times. The pump was removed from service. A ground was found on one cable that runs between the turbine building pull box and the first pull box in the parking lot outside the protected area fence. Cables in this pull box were found submerged in water. The faulted portion and a similar length of the other two cables for this circuit were removed, the water was pumped out of the pull box, a mandrel was passed through the conduit several times to remove any standing water, and new cables were installed. Visual examination found no obvious physical defects in the removed cables. Cable samples were sent to Okonite and to the PG&E Technical and Ecological Services (TES) laboratory for examination and testing. The cable testing determined that the cable met or exceeded the original mechanical and electrical stress limits set forth in the original purchase specification, except for some minor loss of mechanical strength of the jacket material. The testing laboratories determined the failure to be an isolated event.

On May 3, 1992, intermittent ground current alarms were received associated with Unit 1 nonsafety-related 4kV Bus D (EA)(BU). The 4kV Bus D was removed from service. The ground was determined to be located on one cable between the pull box located immediately outside of the intake structure and the Bus 14D transformer (EA)(XFMR) in the intake structure. The pull box located outside of the intake structure was found to have water inside, which was pumped out to facilitate cable replacement. Approximately 40 feet of the single faulted cable was replaced. Visual examination found no obvious physical defects in the removed cable. Cable samples were sent to Okonite and to the PG&E TES laboratory for examination and testing. The examination and testing determined that the physical properties of the insulation were normal and that the jacket properties displayed some loss of elongation which was considered normal for neoprene installed for almost 18 years. The electrical properties were normal



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for 18-year old cable. The testing laboratories could identify no definitive reason for the failure.

On October 31, 1992, ASW Pump 1-2 on Unit 1 was removed from service for refueling outage maintenance. As part of the procedure to return the pump to service, a motor hi-pot test was conducted. During the hi-pot test, the cable insulation developed a ground fault at approximately 6kV. Investigation determined that the fault was located on one cable between the first pull box outside the turbine building and the next pull box at the discharge structure. Cables in this pull box were also found submerged in water. The faulted portion and a similar length of the other two cables for this circuit were removed, the water was pumped out of the pull box, a mandrel was passed through the conduit several times to remove any standing water, and new cables were installed. Other than at the fault point, visual examination revealed no obvious physical defects in the removed cables. Cable samples were sent to Okonite, the PG&E TES laboratory, and Cable Technologies Laboratory (CTL) for examination and testing. In February 1993, an additional sample was sent to Altran Materials for chemical analysis. Test results indicated that the electrical properties of the cable are acceptable, no evidence of manufacturing defects has been identified, and no indication of installation problems or abnormal operating conditions can be identified.

12kV Cable Failures

On February 5, 1993, Unit 1 was ramped down from 100 to 46 percent power due to a ground current alarm for CWP 1-1. While the ground alarm annunciated, smoke was reported in the 12kV switchgear room (NM)(EA)(SWGR) due to ground resistor bank heating of accumulated dust, as is expected during ground fault conditions. An Unusual Event was declared at 2156 PST due to a precautionary assistance request to an offsite agency. An immediate emergency report was made to report the declaration of an Unusual Event in accordance with 10 CFR 50.72(a)(1)(i).

Investigation determined that the ground was located on one cable between the first pull box outside the turbine building and the next pull box at the discharge structure elevation. When the cables were removed, the neoprene jacket was found to be separating from all three cables of the circuit for a distance of approximately 200 feet.

While removing the failed CWP 1-1 cable and a similar length of the other two cables for this circuit from the conduit, water was introduced into the conduit from the discharge structure elevation pull box in order to lubricate the cables for removal. No water came out the pull box at the turbine building end of the conduit run. Investigation determined that the six-inch acrylonitrile-butadiene styrene (ABS) conduit probably was broken, and that this damage had



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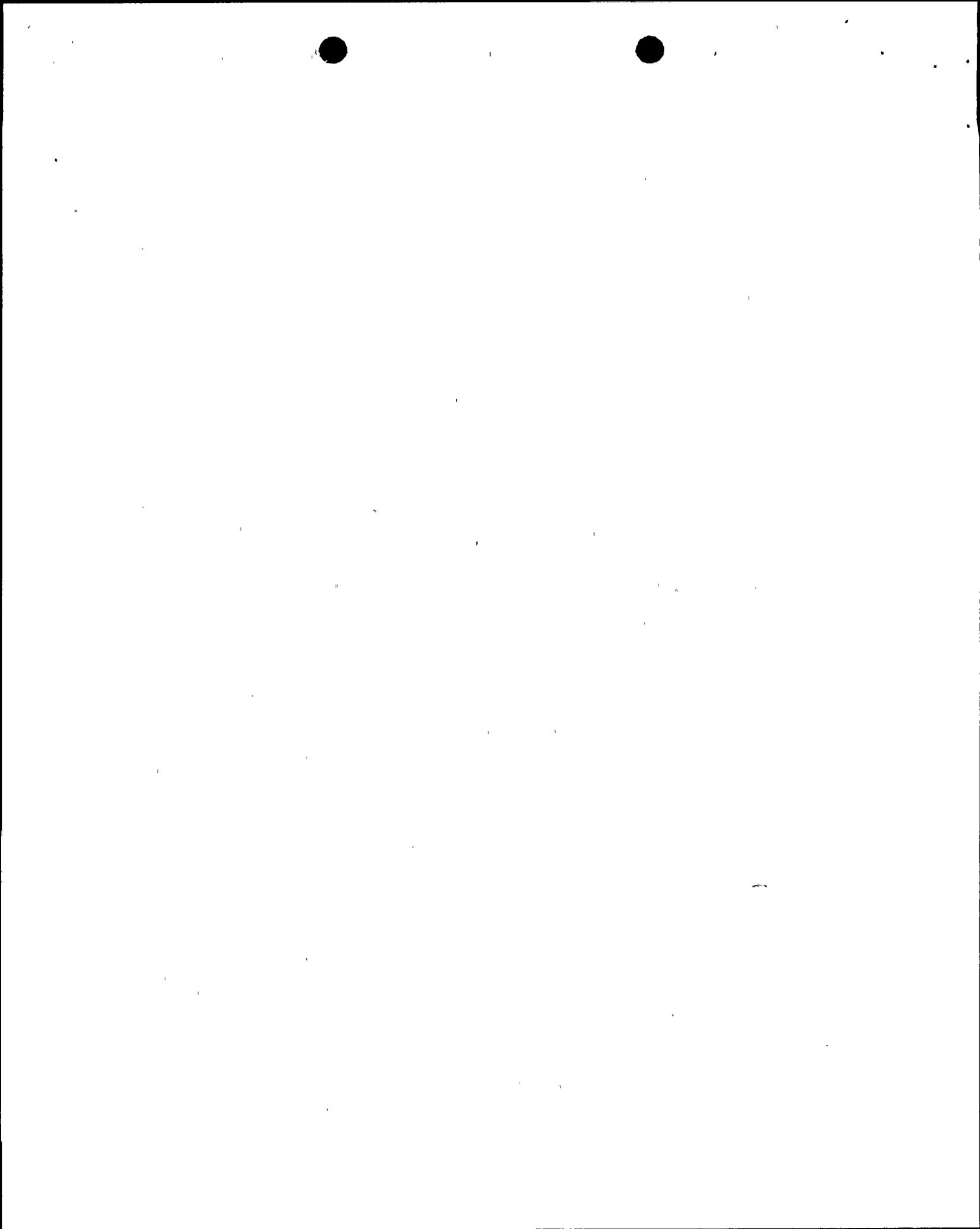
most probably resulted from the initial attempts to remove the cable.

The water was pumped out of the pull box, a mandrel was passed through a spare conduit several times to remove any standing water, and new cables were installed in a spare conduit. When the new cable sections were spliced in, no visual degradation was found at the splice locations. Cable samples were sent to Okonite, the PG&E TES laboratory, and Altran Materials for comprehensive examination and testing. Test results indicated that the outer neoprene jacket had been chemically degraded and the copper shield shows evidence of corrosion. However, electrical properties of the cable are acceptable, no evidence of manufacturing defects has been identified, and no indication of an installation problem or abnormal operating conditions can be found.

On March 12, 1993, intermittent ground current alarms annunciated for Unit 1 CWP 1-2. The Unit was ramped to less than 50 percent power and the pump was secured. Investigations determined that one cable was shorted to ground between the first pull box outside the turbine building and the next pull box at the discharge structure elevation. When the cables were removed, the neoprene jacket was found to be separating from all three cables of the circuit for a distance of approximately 200 feet. There was evidence (pull box water marks) that the cables had previously been submerged in water.

The faulted portion and a similar length of the other two cables for this circuit were removed, a mandrel was passed through the conduit several times to remove any standing water, and new cables were installed. When the new cable sections were spliced in, no visual degradation was found at the splice locations. Cable samples were sent to Okonite, the PG&E TES laboratory, and Altran Materials for examination and testing. Test results indicate that the outer neoprene jacket has been chemically degraded and the copper shield shows evidence of corrosion. However, electrical properties of the cable are acceptable, no evidence of manufacturing defects has been identified, and no indication of installation or abnormal operating conditions can be identified.

Following the March 12 event, PG&E conservatively replaced other Unit 1 non-failed medium voltage circuits between the pull boxes outside the turbine building and the next pull box at the discharge structure elevation (ASW Pump 1-1 4kV cables and the second 3-phase 12kV circuits for CWPs 1-1 and 1-2). Also, one complete circuit, between the turbine building switchgear and the motor terminations at the intake structure, of the Unit 2 12kV CWP 2-1 motor feeder circuits was replaced. The neoprene jacket on the Unit 1 12kV CWP cables showed evidence of chemical degradation, similar to that on the previously replaced Unit 1 12kV CWP circuits. Visual examination of the ASW 1-1 4kV cables and the CWP 2-1 12kV cables revealed no



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defects.

**D. Inoperable Structures, Components, or Systems that Contributed to the Event:**

SM-1 and SM-2 are the pull box drain systems and associated sump pumps for Units 1 and 2, respectively, for the pull boxes immediately outside of the turbine building. Investigation determined that water had accumulated in the pull boxes as a result of the pull box drain systems and associated sump pumps not being functional for a period of time preceding the cable failure events.

**E. Dates and Approximate Times for Major Occurrences:**

1. October 29, 1989:                   A Unit 2 ASW Pump 2-2 4kV cable ground alarm was received.
2. May 3, 1992:                        A Unit 1 nonsafety-related Bus 14D 4kV cable ground alarm was received.
3. October 31, 1992:                 Unit 1 ASW Pump 1-2 4kV cable degradation was detected during maintenance hi-pot testing.
4. February 5, 1993:                 A Unit 1 nonsafety-related CWP 1-1 12kV cable ground alarm was received.
5. March 12, 1993:                   A Unit 1 nonsafety-related CWP 1-2 12kV cable ground alarm was received.

**F. Other Systems or Secondary Functions Affected:**

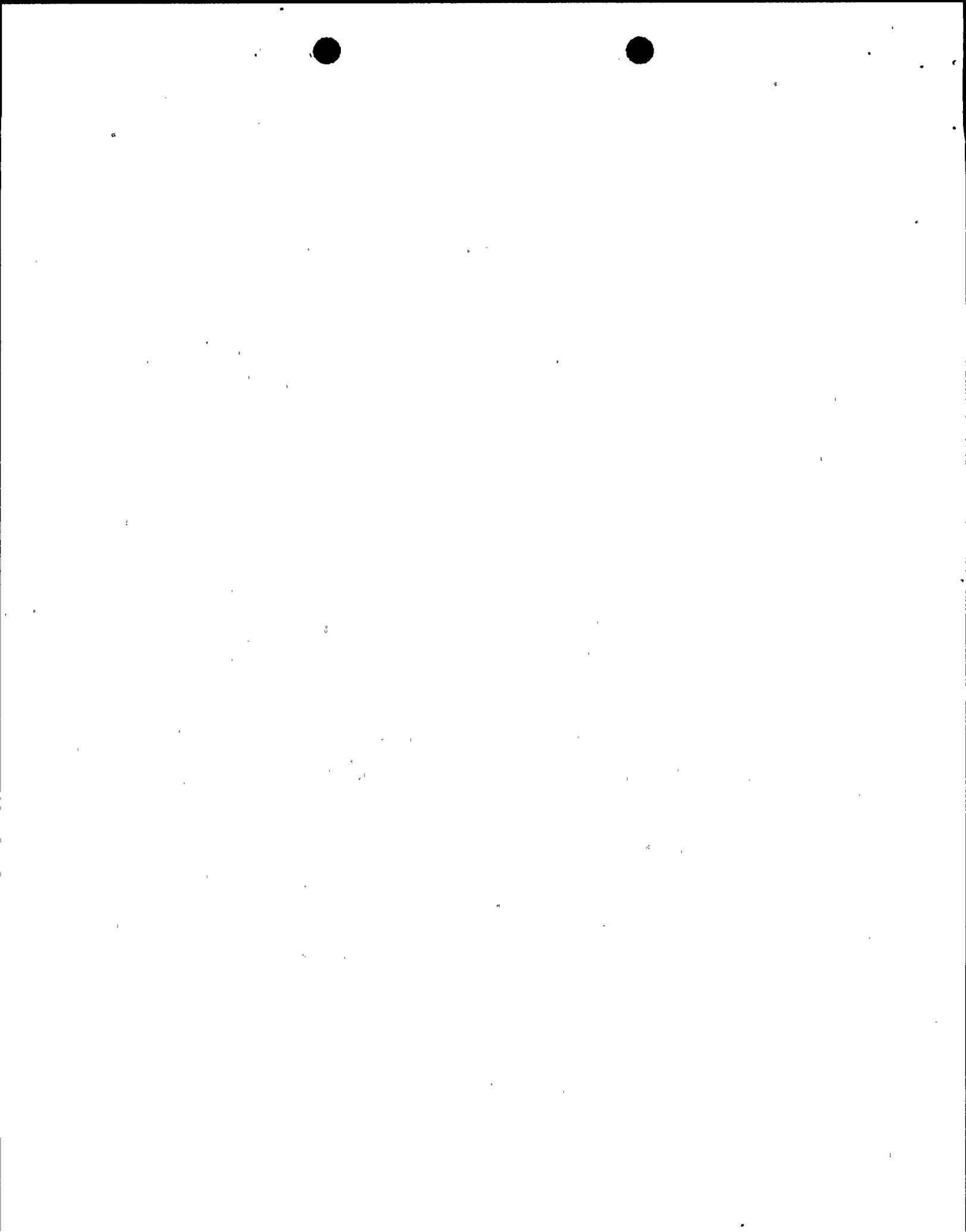
None.

**G. Method of Discovery:**

1. The four "in-service" cable failures were immediately apparent to plant operators due to ground fault alarms and indications received in the control room (NA).
2. The ASW Pump 1-2 4kV cable degradation was found during maintenance when Electrical Maintenance personnel observed that the cable failed to pass its hi-pot test.

**H. Operator Actions:**

For the four "in-service" events, the associated equipment was removed from service and troubleshooting activities were initiated.



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**I. Safety System Responses:**

None.

**III. Cause of the Event**

**A. Immediate Cause:**

1. For the four "in-service" cable failures, the immediate cause was a conduction path to ground, which resulted in sufficient current to flow through the ground detection circuitry.
2. For the ASW Pump 1-2 4kV cable degradation, the immediate cause was failure of the cable to withstand the hi-pot test voltage during post-maintenance activities.

**B. Root Cause:**

Extensive root cause investigation has been conducted since the first cable failure in 1989. The root cause analysis involved thorough investigation into all design aspects of the cable and associated trenches, a review of available historic information with respect to purchase, construction, and maintenance history, a review of vendor and industry operating experience information, and completion of extensive laboratory analysis of the failed cable and sump fluid samples.

The following categories of possible root causes for the cable failures were reviewed:

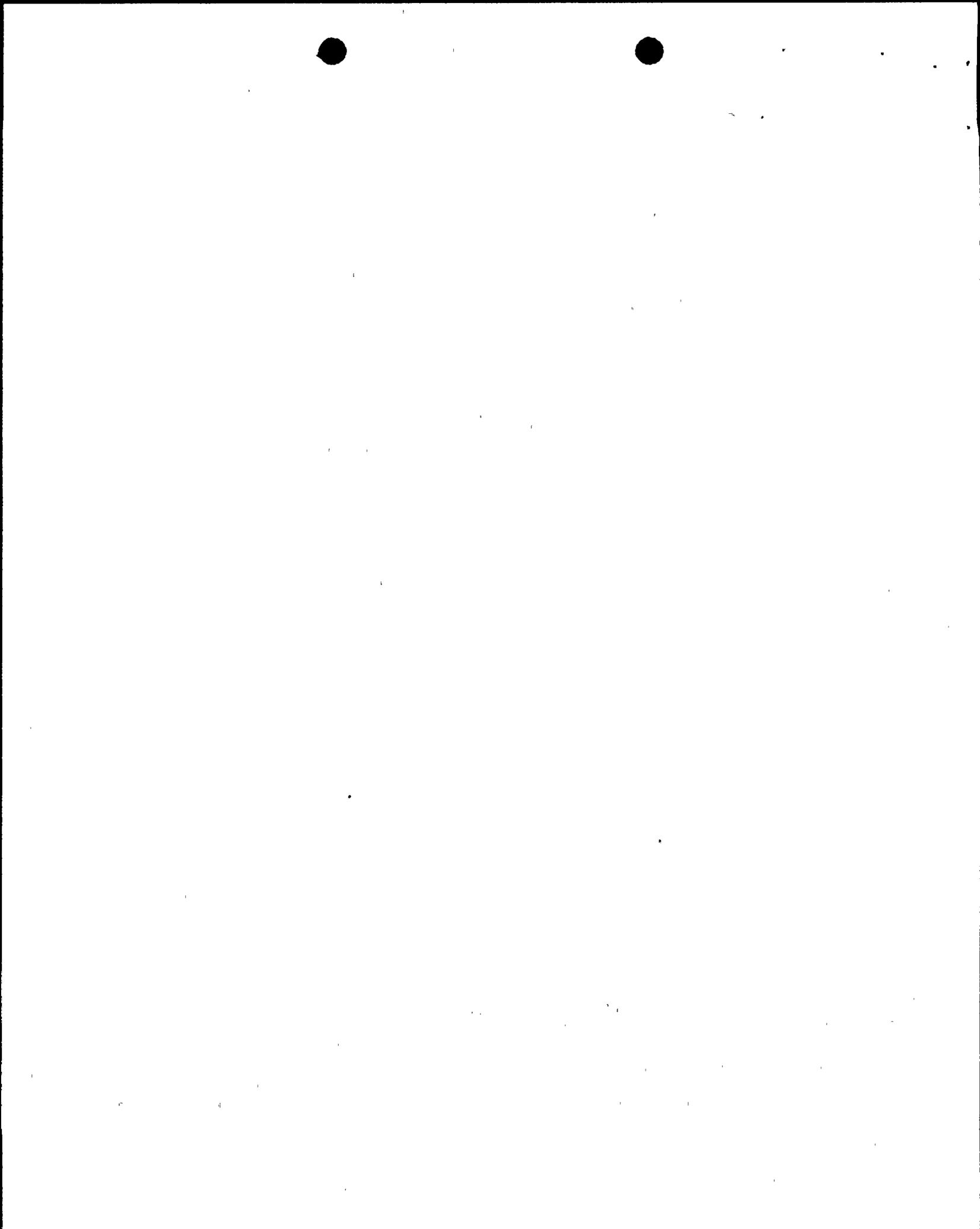
**1. Manufacturing Defects**

Extensive cable dissection, wafer slicing and staining, and examination have not identified any impurities, contaminants, or significant voids in the cable insulation that would result in cable failure. Based on acceptable voltage breakdown testing and outage frequency hi-pot testing (i.e. no common mode failure mechanism), there is no basis to assume imminent failure due to point defects.

**2. Installation**

Cable pulling tensions for the Unit 1 4kV and 12kV cables routed between the turbine building and the intake structure were evaluated. The evaluation concluded that the vendor specified pulling tension and sidewall pressure limits were not exceeded.

A review of the pulling compounds used during construction was



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completed. These pulling compounds were appropriate for the installation of Okonite 4kV and 12kV cables and therefore did not contribute to the cable failures.

Based on video probe inspections and the ease of cable replacement, the duct bank is intact, except for the conduit section damaged during CWP 1-1 cable removal, which is no longer used.

### 3. Operating Environment

**Moisture Intrusion:** The cable design basis is for wet and/or dry conditions. The cable can be submerged for prolonged periods. Inquiries to other nuclear power plants did not identify any trends for medium voltage EPR insulated cable failures in similar applications. The Okonite black EPR cable is widely used in electric utility distribution systems, including PG&E (five million feet has been installed in the PG&E distribution system for a longer period of time than the DCPD cables), and has been highly reliable in similar applications.

**Chemical Attack:** Laboratory chemical analysis results have established that the 12kV neoprene jacket was attacked by a chloride and fatty acid. High ambient temperatures accelerate the chemical related jacket degradation. PG&E has evaluated the cable operating temperature and estimated that, in the worst case, the 12kV CWP cables are operating with conductor temperatures in the range of 80 to 85°C. The 4kV cables operate at a significantly lower temperature (60 to 70°C, based on self-heating) due to loading requirements. The hypothesized method of chemical migration and degradation is by way of water that intruded into the conduits through the cable pull boxes that are located immediately outside of the turbine building; the water intrusion resulted from the inoperable sump pumps and associated pull box drainage system.

Based on the presence of water in the pull boxes, specific analysis for water-related degradation was completed. The results of this laboratory analysis showed no evidence of water damage in the EPR insulation, and the copper shield shows no signs of corrosion. Therefore, the role of water appears to be limited to the 12 kV cable failures as a possible transport fluid for the contaminant that degraded first, the cable jacket and subsequently the shield.

The Unit 2 CWP 2-1 cables, which were replaced in the Unit 2 fifth refueling outage, showed no evidence of chemical attack. Therefore, the chemical attack was limited to Unit 1.



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Maintenance Testing: The routine maintenance hi-pot testing of the 4kV and 12kV cables is within vendor recommended values and does not electrically overstress the cable.

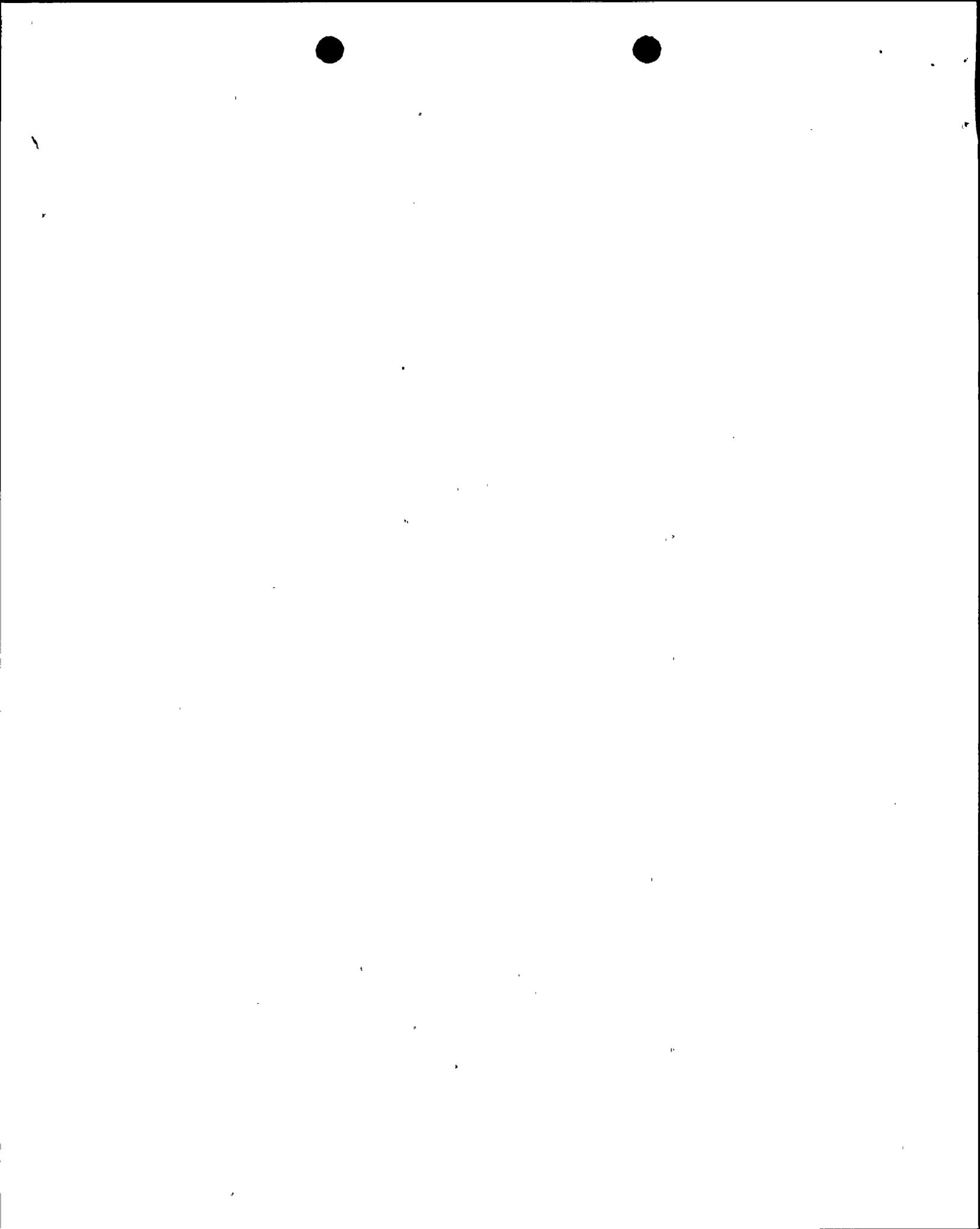
Summary

PG&E has concluded that the root cause for the 12kV cables is chemical degradation of the neoprene jacket, resulting in subsequent corrosion of the copper shield. Loss of shield continuity allowed for the concentration of electrical stress to reach a magnitude that caused a breakdown of the cable insulation, ultimately resulting in a cable ground. Chemical analyses identified the remains of a fatty acid, ethyl ester compound, and excess chlorides. The specific agent and its source has not been identified. This contaminant caused severe decomposition of the cable jackets, allowing saline water within the duct banks to attack the copper tape shields. Chemical damage to the jackets of the 12kV cable may have been facilitated by their lower degree of cross linking, compared to 4kV cables, and a higher normal operating temperature. The difference in amount of cross linking is due to the thermal mass of the two cables and differing cooling rates during manufacturing.

PG&E believes that the 12kV cable failures occurred over an extended period of time (greater than a year). This conclusion is based on the relatively mild pH (approximately 8.5) of the liquid found beneath the neoprene jacket and the copper shield binding tape showing no evidence of high cable operating temperatures (the binding tape melts at approximately 85°C). The analysis of liquid samples taken from under cable jackets, ducts and sumps indicated that the liquid composition was similar to sea water and indicated that the attacking agent was no longer present.

The 4kV cables revealed no positive evidence to enable determination of a root cause for the failures. Review of laboratory results has determined that the failure of the 4kV cable was not caused by chemical degradation, installation damage, manufacturing defects, a collapsed duct bank, electrical operating or testing stresses, nor thermal aging. The 4kV cables demonstrate good voltage withstand test and show no evidence of significant voids or impurities in the EPR insulation material; there is no evidence of corrosion on the copper tape shield, and the jacket is in good mechanical condition. Therefore, the cause for 4kV cable failures is attributed to localized point defects or other anomalies that have occurred randomly in time.

Cables rated 600 volts or less experience lower electrical stress and, therefore, do not require a shield to equalize the electrical equipotential between the conductor and ground. Visual examination of cables rated 600 volts and lower show no obvious signs of physical degradation. Furthermore, laboratory analysis of a low voltage



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control cable removed from the ASW 1-1 pull box near the turbine building, identified the presence of the same compound which damaged the 12kV cable jacket. However, the cable is functional and in acceptable condition based on minimal corrosion of the conductor and the insulation itself being undamaged. Low voltage control and instrument cable is subjected to very low electrical stresses compared to medium voltage cable and operates considerably cooler. A review of some instrument calibration records showed no adverse trends that would be indicative of cable degradation.

#### IV. Analysis of the Event

The 4kV power and associated control circuits potentially affected by these cable failures are associated with the ASW pumps. The 12kV power and associated control circuits potentially affected by these cable failures are associated with the CWPs.

The ASW system has a safety-related function to remove heat from other safety-related system components during normal operation and plant shutdown via the component cooling water (CCW)(CC) system. The ASW system also provides vital cooling necessary for the engineered safeguards feature (ESF) systems to perform their functions. Each DCPD unit has two redundant ASW trains, each consisting of a full capacity ASW pump and associated piping to supply the CCW heat exchanger. The ASW pump motors are supplied by vital 4kV power. The ASW trains within a unit can be cross-tied to allow either of the ASW pumps to supply either CCW heat exchanger. In addition, both units' ASW trains can be cross-tied to add further redundancy to the system.

The motor-driven CWPs are part of the saltwater system which removes energy from the turbine exhaust steam (SG) entering the main condenser (SG)(COND) by providing cooling water to the condenser. Each unit is provided with two nonsafety-related 12kV motor-driven pumps located in the intake structure. At 100 percent unit power level, both pumps must run to support full load operation.

In all cases, DCPD has ground detection alarms that provide indication that a potential cable problem exists. Upon receipt of this alarm, troubleshooting activities will determine the location of the problem, and the situation will be remedied.

A portion of the ASW pumps control circuitry is fed from the 125V dc system, which is an ungrounded system. The occurrence of a ground in any 125V dc circuit is alarmed, but does not affect the operation of the circuit itself.

The 12kV and 4kV systems have high-resistance grounding, and the 480V system is ungrounded, which allows continued operation for a limited time in the event of a single-line-to-ground fault. Operators have received simulator training on ground fault incidents. The normal plant procedure, as demonstrated in the past failure incidents, is to declare the associated



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component inoperable, and then troubleshoot and repair the faulted circuit. The ground detection system, as well as additional control room indication (i.e., red/green lights associated with the motors), provide sufficient time to identify and correct a problem prior to another failure causing a portion of a mutually redundant system from becoming inoperable.

Loss of 120V ac control or low power instrument circuits does not affect the operability of any safety-related components.

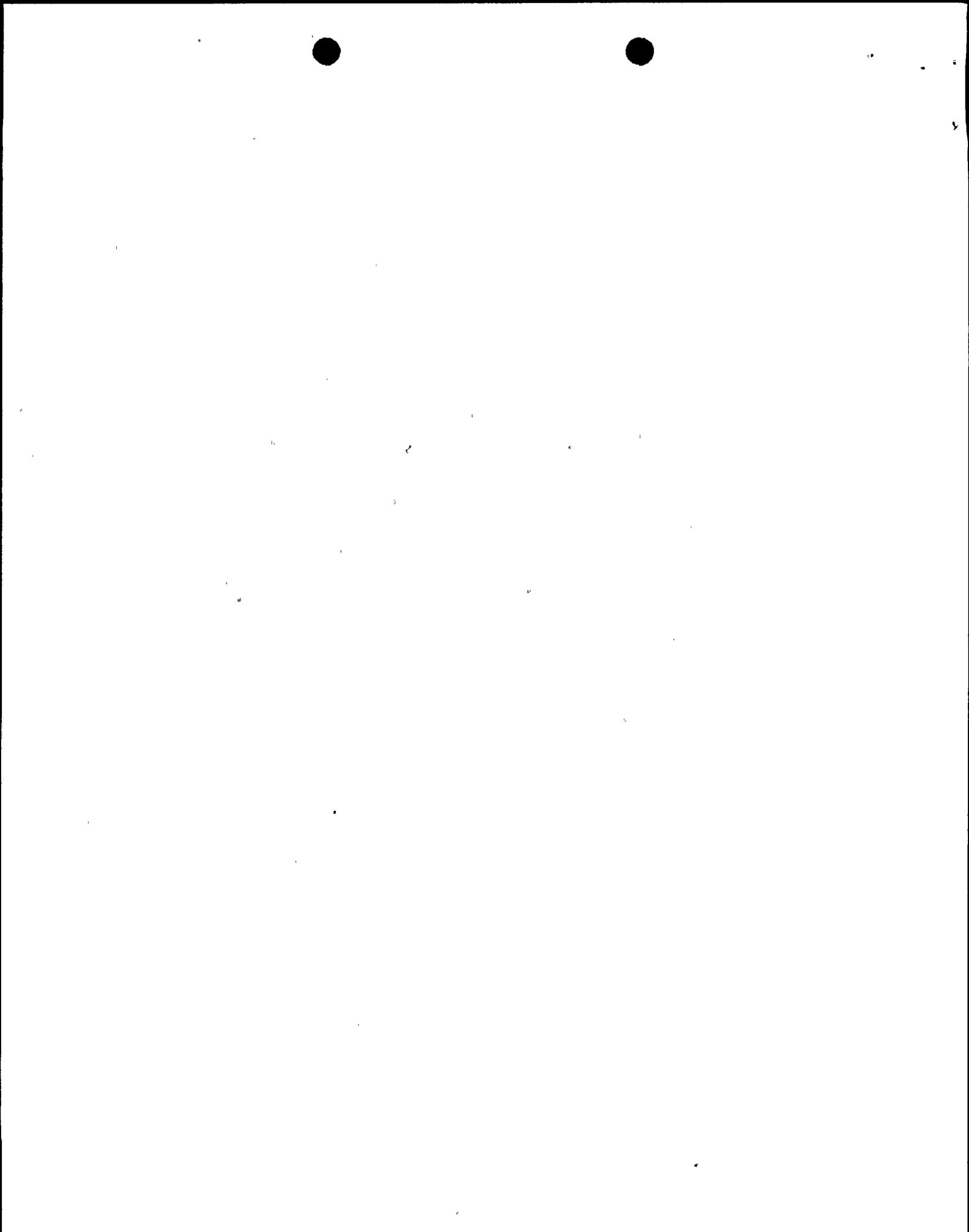
The ability to operate for a limited time with a ground on the CWP's ensures that time is available to bring the plant to a stable condition where the affected pump can be removed from service and the circuit repaired without challenging any safety systems.

In summary, since both ASW trains are electrically separate and independent, a cable fault in one ASW train would not have prevented the other train from performing its safety-related function. Furthermore, since the failures have been separated in time, and diagnostic examinations of the failed cables and additional "non-failed" cables show no evidence that additional failures are imminent, the probability of a design basis accident followed by a random 4kV cable failure is considered to be very low. In addition, as discussed above, the ASW system can be cross-connected to the ASW system of the other unit. This helps maintain the ability to perform the ASW system safety function of the unit with a design basis accident. Thus, the health and safety of the public were not affected by this event.

V. Corrective Actions

A. Immediate Corrective Actions:

1. All Unit 1 4kV ASW pump and 12kV CWP cables between the turbine building and the discharge structure elevation pull boxes, which were potentially exposed to standing water and chemicals, were replaced. The replacement cable has an improved Hypalon jacketing material. The Hypalon jacket has superior performance over neoprene in wet environments and exposure to alkaline solutions.
2. PG&E TES, Okonite, and two independent laboratories were sent 4kV and 12kV cable samples for chemical, electrical, and mechanical examination and testing.
3. After the event on March 12, 1993, there was concern that the degradation might also be present in Unit 2 similar cables. Therefore, one circuit of the 12kV CWP 2-1 motor feeder circuit was replaced from the switchgear to the intake structure to verify the condition of the Unit 2 12kV cables. Visual examination revealed no defects in the removed cable. Unit 2 has not experienced any 12kV CWP cable failures.



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4. The pull boxes were pumped dry, drains cleaned, and the sump pumps for the first outside pull boxes were overhauled and returned to service.

**B. Corrective Actions to Prevent Recurrence:**

Based on extensive research, the existing 4kV and 12kV cables are fully appropriate in their current applications. The following actions will provide additional assurance that no further cable failures will occur:

1. A formal preventive maintenance program has been established for the sump pumps and drains immediately outside the turbine building. In addition, the box lid seals associated with these pull boxes will be replaced, and the sump level alarm indication system will be re-established.
2. Inspection access and pump-out capability for pull boxes between the turbine building and the intake structure for both units will be provided.
3. As a prudent measure, a new cable specification and associated design changes are being investigated for future installations of underground medium voltage cable (4kV and 12kV). This specification will be similar to the existing medium voltage power cable specification, except the jacket material will be changed to a material that is more resistant to chemical attack.
4. As a further prudent measure, during the next Unit 1 refueling outage, scheduled for March of 1994, one complete circuit from the turbine building 4kV switchgear to the motor terminations at the intake structure for ASW pump 1-2 will be replaced and cable samples will be obtained and evaluated.

**VI. Additional Information**

**A. Failed Components:**

Component: Medium Voltage Cable  
 Manufacturer: Okonite  
 Model Number: 5kV & 15kV Rated, w/ 133 percent insulation level  
 Type: EPR Black Insulation w/ neoprene jacket.

**B. Previous LERs on Similar Problems:**

None.



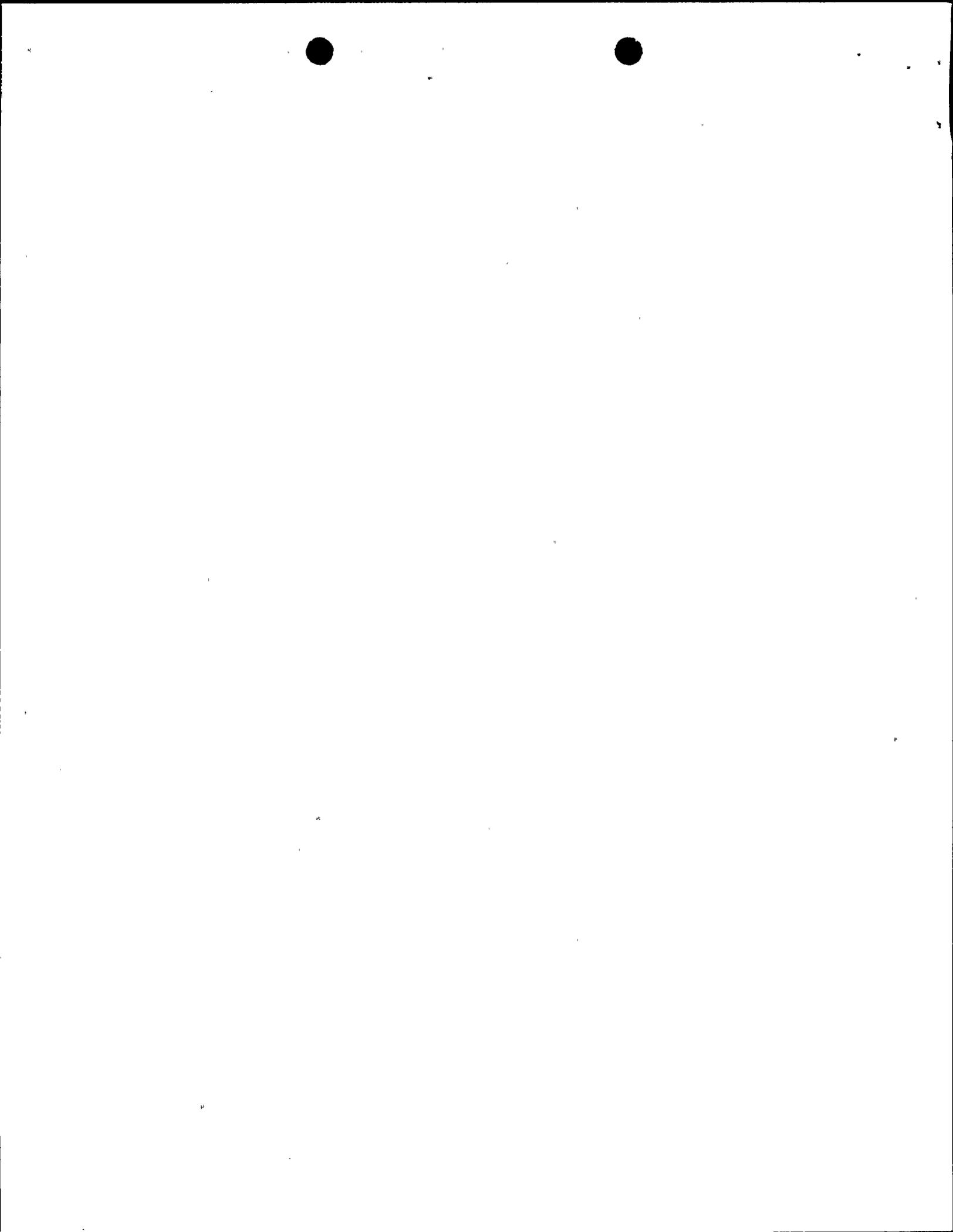
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- C. NRC Information Notice (IN) 92-81, "Potential Deficiency of Electrical Cables with Bonded Hypalon Jackets," dated December 11, 1992

As part of the root cause investigation, IN 92-81 was reviewed for applicability to the cable failures at DCP. IN 92-81 was determined to not be applicable to the DCP cable failures since neither the 4kV nor the 12kV cable jackets are bonded to the cable shield/insulation.

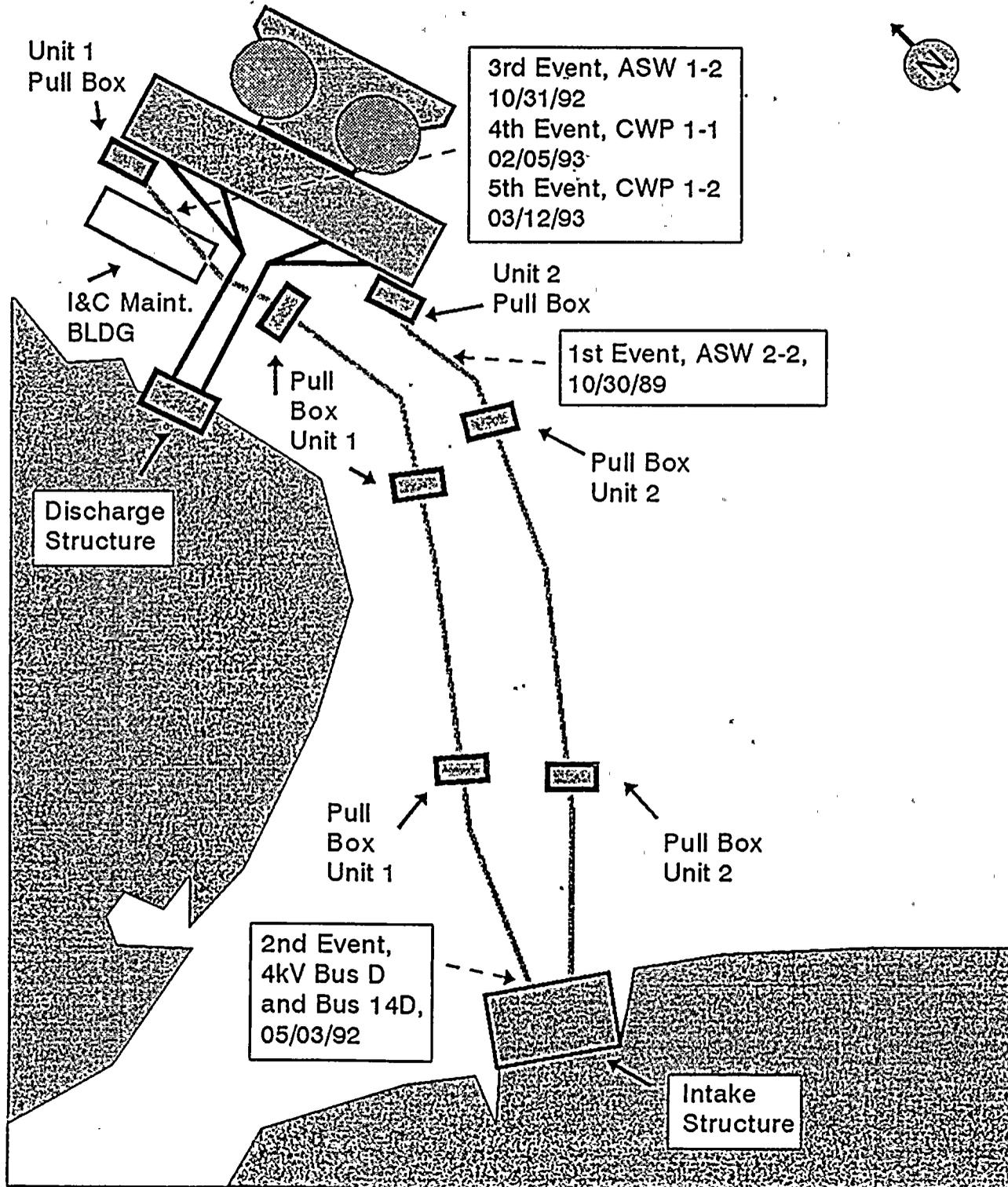


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## Figure 1: Site Overview of Conduit Trench for Units 1 & 2



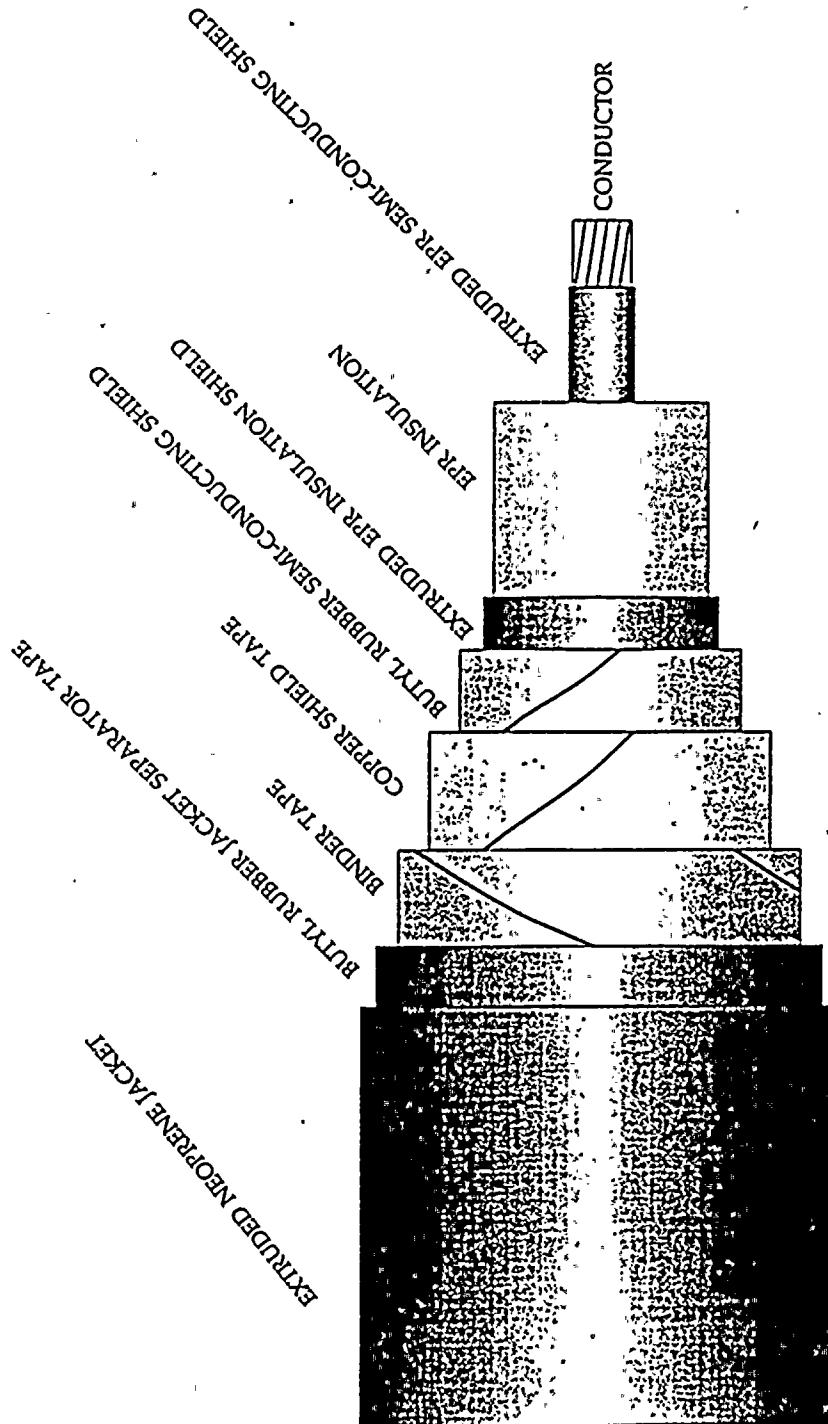


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**FIGURE 2 : DESIGN OF 4KV AND 12KV OKONITE CABLES**



from: Altran Materials Engineering  
 March, 1993  
 - NOT TO SCALE -

Construction of Okonite 5kV and 15 kV Cables Used at DCCP

