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Evaluation of Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment

Appendices A, B, and C

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DOCUMENTS IN SERIES

This report is one of a series of reports documenting the technical findings associated with the resolution of Generic Issue 57: Effects of Fire Protection Systems on Safety-Related Equipment.

There are several reports published in association with the resolution of Generic Issue 57. These are:

NUREG/CR-5580, SAND90-1507, Evaluation of Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment, Main Report, December 1992.

NUREG/CR-5789, SAND91-1534, Risk Evaluation for a Westinghouse PWR, Effects of Fire Protection System Actuation on Safety-Related Equipment: Evaluation of Generic Issue 57, December 1992.

NUREG/CR-5791, SAND91-1536, Risk Evaluation for a General Electric BWR, Effects of Fire Protection System Actuation on Safety-Related Equipment: Evaluation of Generic Issue 57, December 1992.

NUREG/CR-5790, SAND91-1535, Risk Evaluation for a Babcock & Wilcox Pressurized Water Reactor, Effects of Fire Protection System Actuation on Safety-Related Equipment (Evaluation of Generic Issue 57), September 1992.

NUREG/CR-5906, SAND92-1547, Decision Making Under Uncertainty: An Investigation Into the Application of Formal Decision-Making Methods to Safety Issue Decisions, December 1992.

Letter Report, EGG-NTA-9081, Risk Evaluation of a Westinghouse 4-Loop PWR, Effects of Fire Protection System Actuation on Safety-Related Equipment (Evaluation of Generic Issue 57), Idaho National Engineering Laboratory, December 1991.

Letter Report, Seismic Risk Evaluation for a Pressurized Water Reactor, Effects of Fire Protection System Actuation on Safety-Related Equipment, Sandia National Laboratories, December 1991.

ABSTRACT

Nuclear power plants have experienced actuations of fire protection systems (FPSs) under conditions for which these systems were not intended to actuate and also have experienced advertent actuations with the presence of a fire. These actuations have often damaged safety-related equipment.

A review of the impact of past occurrences of both types of such events and their impact on plant safety systems, an analysis of the risk impacts of such events on nuclear power plant safety, and a cost-benefit analysis of potential corrective measures have been performed. Thirteen different scenarios leading to actuation of fire protection systems due to a variety of causes were identified. These scenarios ranged from inadvertent actuation caused by human error to hardware failure, and include seismic root causes and seismic/fire interactions. A quantification of these thirteen root causes, where applicable, was performed on generically applicable scenarios.

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FPS ACTUATION

This Appendix provides the historical data for fire protection system actuations, both advertent and inadvertent, in U.S. commercial nuclear power plants for the period January 1, 1980 to December 31, 1989.

The Appendix is divided into three parts:

a. Appendix A.1 provides the set of 121 LER summary checklist forms for inadvertent FPS actuations that occurred after initial criticality.

b. Appendix A.2 provides the set of 17 LER summary checklist forms for those FPS actuations categorized as advertent.

c. Appendix A.3 provides event data checklists for 12 events that are of interest but that occurred prior to initial criticality.

Alphabetical Index - Appendix A.1

Alphabetical Index - Appendix A.1 (Continued)

Alphabetical Index - Appendix A.1 (Concluded)

Alphabetical Index - Appendix A.2

Alphabetical Index - Appendix A.3

Appendix A.1

Inadvertent FPS Actuations

Form #	Docket	Year	LER #
3-1	029	81	028

Actuation of Fire Suppression Systems Checklist

1. Plant: **Yankee Rowe** Type: **PWR**

2. Date of Incident: **10/15/81**

3. % Power/Mode? **Unknown**

4. Initiator? **Mechanical fitting failure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: X Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Check valve fitting**

9. Affected area(s) of plant? **Battery room**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While attempting to disconnect a Halon bottle trip solenoid, the No. 1 battery room Halon bottle accidentally discharged. An upstream fitting loosened because the check valve assembly turned at the bottle instead of the solenoid nut. No apparent damage to other equipment.**

Form #	Docket	Year	LER #
2-11	219	80	044

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oyster Creek** Type: **BWR**

2. Date of Incident: **9/30/80**

3. % Power/Mode? **99%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **Core spray**

11. Critical systems? **Yes**

12. Affected equipment? **Core spray booster pumps - motor leads**

13. Critical equipment? **Yes**

14. Failure mode? **Wetting of pump motor wiring**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Maintenance personnel not following proper procedures inadvertently actuated fire protection system over core spray booster pumps, wetting booster pump motor leads. Details on how the FPS was actuated were not specified.**

Form #	Docket	Year	LER #
2-13	219	85	012

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oyster Creek** Type: **BWR**
2. Date of Incident: **6/12/85**
3. % Power/Mode? **100%**
4. Initiator? **Steam from Scram Discharge Volume**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Reactor Building - 51' Elevation**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **Yes**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **During an automatic reactor scram, one of two scram discharge volumes did not isolate. Escaping steam from the unisolated scram discharge volume actuated the deluge system at the reactor building 51' elevation. Subsequently, a cleanup system isolation valve failed to open on command because its breaker had tripped. (It is not clear whether the deluge caused the breaker trip). Manual procedures were used to complete the reactor shutdown.**

Form #	Docket	Year	LER #
2-14	219	87	031

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oyster Creek** Type: BWR

2. Date of Incident: **8/27/87**

3. % Power/Mode? **99%**

4. Initiator? **Steam leak opened sprinkler head fusible link**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Sprinkler fusible link**

9. Affected area(s) of plant? **Turbine Building condenser bay**

10. Affected plant system(s)? **Secondary side steam, condensate**

11. Critical systems? **No**

12. Affected equipment? **Instrumentation**

13. Critical equipment? **No**

14. Failure mode? **Erratic instrumentation readings**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **With a fire alarm, and no indication of an actual fire, the shift supervisor had the condenser bay sprinkler system isolated. Indications caused him to suspect sprinkler actuation which was causing erratic instrumentation readings and threatening a turbine trip. It was confirmed that a single sprinkler head did open due to a steam leak. Similar sprinkler actuations had also occurred on July 22, 1987, and August 22, 1987.**

Form #	Docket	Year	LER #
2-16	237	81	079

Actuation of Fire Suppression Systems Checklist

1. Plant: **Dresden 2** Type: **BWR**

2. Date of Incident: **12/23/81**

3. % Power/Mode? **100%**

4. Initiator? **High humidity/dust in HPCI room**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Ionization detector**

9. Affected area(s) of plant? **HPCI room**

10. Affected plant system(s)? **HPCI system**

11. Critical systems? **Yes**

12. Affected equipment? **HPCI system components**

13. Critical equipment? **Yes**

14. Failure mode? **Water in HPCI oil sample**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During normal operation, high humidity and dust particle concentration in HPCI room set off an ionization detector, actuating fire deluge system. Water was found in an HPCI oil sample, so HPCI was declared inoperable. Coincidentally, the auto-depressurization system was found to be inoperable because of a broken wire.**

Form #	Docket	Year	LER #
2-18	237	87	011

Actuation of Fire Suppression Systems Checklist

1. Plant: **Dresden 2** Type: **BWR**

2. Date of Incident: **4/9/87**

3. % Power/Mode? **0%**

4. Initiator? **Contractor personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other:

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Auxiliary Electric Equipment Room**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Contractor personnel inadvertently actuated Halon fire suppression system in the auxiliary electric equipment room. No plant equipment was damaged, although the Halon system was temporarily inoperable.**

Form #	Docket	Year	LER #
2-19	244	81	019

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**
2. Date of Incident: **11/14/81**
3. % Power/Mode? **Unknown (Fire scoping study says 100%)**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **Several**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Control circuits to solenoid valves**
9. Affected area(s) of plant? **Several (unspecified)**
10. Affected plant system(s)? **Reactor Protection System, Control Rod Drive System**
11. Critical systems? **Yes**
12. Affected equipment? **RPS motor generator set, CRD switchgear cabinet**
13. Critical equipment? **Yes**
14. Failure mode? **Trip of RPS motor generator, water shorted CRD circuits**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **During a test on satellite station "A", workers inadvertently activated the control circuits to the water spray solenoid valve actuators, actuating the sprinkler systems in several plant areas. Some water entered the control rod drive switchgear cabinet, causing two control rods to be misaligned to the fully withdrawn position. The water also tripped one Reactor Protection System motor generator set. Operators manually tripped the reactor.**

Form #	Docket	Year	LER #
2-21	249	81	039

Actuation of Fire Suppression Systems Checklist

1. Plant: **Dresden 3** Type: **BWR**

2. Date of Incident: **11/30/81**

3. % Power/Mode? **Unit startup**

4. Initiator? **High heat and humidity**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Ionization detector in HPCI room**

9. Affected area(s) of plant? **HPCI room**

10. Affected plant system(s)? **HPCI system**

11. Critical systems? **Yes**

12. Affected equipment? **Unspecified HPCI components**

13. Critical equipment? **Yes**

14. Failure mode? **Water damage to HPCI**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During unit startup, high steam concentration and high temperature in the HPCI room activated an ionization-type fire detector. The detector then actuated the HPCI room deluge system. The deluge water damaged unspecified HPCI equipment in the room because of poor shielding and sealing from the water spray. The HPCI system was isolated and the unit was shutdown.**

Form #	Docket	Year	LER #
4-146	249	83	017

Actuation of Fire Suppression Systems Checklist

1. Plant: **Dresden 3** Type: **BWR**

2. Date of Incident: **5/4/83**

3. % Power/Mode? **99%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Unknown**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **HPCI room**

10. Affected plant system(s)? **Yes**

11. Critical systems? **Yes**

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **Unknown**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge valve failed to reset after an actuation of the HPCI deluge system. Not specified whether the actuation was inadvertent or due to FPS testing.**

Form #	Docket	Year	LER #
4-147	249	83	034

Actuation of Fire Suppression Systems Checklist

1. Plant: **Dresden 3** Type: **BWR**

2. Date of Incident: **9/23/83**

3. % Power/Mode? **64%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Drain valve broken**

9. Affected area(s) of plant? **Unit 3 trackway**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While moving a railcar from the Unit 3 trackway, the boom of the crane hit and broke the wetpipe sprinkler drain valve. Fire water sprayed the trackway area. The system was isolated and no damage was reported.**

Form #	Docket	Year	LER #
2-22	254	89	022

Actuation of Fire Suppression Systems Checklist

1. Plant: **Quad Cities 1** Type: **BWR**

2. Date of Incident: **11/28/89**

3. % Power/Mode? **10%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **None known**

9. Affected area(s) of plant? **HPCI room**

10. Affected plant system(s)? **HPCI**

11. Critical systems? **Yes**

12. Affected equipment? **HPCI turbine electrical equipment**

13. Critical equipment? **Yes**

14. Failure mode? **Electrical equipment grounds due to moisture intrusion**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While operating personnel were attempting to return the HPCI room deluge system to service, the deluge system inadvertently actuated for unknown reasons. Moisture intrusion caused DC system grounds in various electrical equipment. A preaction system was installed to help prevent future actuations.**

Form #	Docket	Year	LER #
4-189	255	81	006

Actuation of Fire Suppression Systems Checklist

1. Plant: **Palisades** Type: **PWR**

2. Date of Incident: **1/19/81**

3. % Power/Mode? **99%**

4. Initiator? **Valve failure due to overtightening bonnet (personnel)**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Drain valve**

9. Affected area(s) of plant? **Cable penetration room**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During sprinkler system testing, a drain valve in the sprinkler supply line failed. It had had a previous history of leakage, controlled by tightening the valve bonnet. Apparently, overtightening caused the failure whereby the bonnet separated from the valve body.**

Form #	Docket	Year	LER #
2-24	255	87	016

Actuation of Fire Suppression Systems Checklist

1. Plant: **Palisades** Type: **PWR**

2. Date of Incident: **5/22/87**

3. % Power/Mode? **40%**

4. Initiator? **Steam rupture caused by personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Sprinkler heads**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **Yes, manual reactor trip**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Maintenance personnel errantly closed the main feed water pump turbine drive exhaust valve, causing the turbine drive overpressure protection disc to rupture. The escaping high temperature steam actuated local fire protection sprinklers. Operators then initiated a plant scram. Apparently, no equipment was damaged by the sprinklers.**

Form #	Docket	Year	LER #
2-25	255	87	024

Actuation of Fire Suppression Systems Checklist

1. Plant: **Palisades** Type: **PWR**

2. Date of Incident: **7/14/87**

3. % Power/Mode? **91%**

4. Initiator? **Errant maintenance procedure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Electric transmission**

11. Critical systems? **Yes**

12. Affected equipment? **1-1, 1-2, 1-3 startup transformers**

13. Critical equipment? **Yes**

14. Failure mode? **Water and wind combine to ground 1-2 transformer**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge system for the startup transformers was inadvertently actuated during maintenance. Water grounded the 1-2 startup transformer. This ground actuated relays which tripped the breakers for the 1-1, 1-2, and 1-3 startup transformers, thereby causing a loss of offsite power. The reactor was then manually tripped.**

Form #	Docket	Year	LER #
2-27	259	86	014

Actuation of Fire Suppression Systems Checklist

1. Plant: **Browns Ferry 1** Type: **BWR**

2. Date of Incident: **5/3/86**

3. % Power/Mode? **0%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Spray valves**

9. Affected area(s) of plant? **Drywell area (Reactor Building)**

10. Affected plant system(s)? **Instrumentation, Engineered Safety Features**

11. Critical systems? **Yes**

12. Affected equipment? **Drywell pressure switches; diesel generators; emergency cooling water pumps; core spray valves**

13. Critical equipment? **Yes**

14. Failure mode? **Water shorted switch contacts**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An electrical short in the high dry well pressure sensors caused a false high pressure signal to be generated. The cause of the short was moisture in the sensors from an unspecified spurious fire spray actuation eight days earlier. The false high pressure signal actuated several engineered safety features, including all 8 diesel generators, 2 emergency equipment cooling water pumps, and the core spray injection valves. Since the reactor was shutdown, the impact was not serious. However, 30,000 gallons of contaminated water did spill into the lower part of the reactor building.**

Form #	Docket	Year	LER #
5-3	259	89	028

Actuation of Fire Suppression Systems Checklist

1. Plant: **Browns Ferry 1** Type: **BWR**

2. Date of Incident: **12/28/89**

3. % Power/Mode? **0%**

4. Initiator? **Valve failure to reset**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **Electric transmission/distribution**

11. Critical systems? **Yes**

12. Affected equipment? **500 KV shunt reactors**

13. Critical equipment? **Yes**

14. Failure mode? **Faulting of shunt reactor "B" phase**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While attempting to flush debris from the high pressure fire protection system deluge valve, the deluge valve failed to reset. Full flow discharge onto the 500 KV shunt reactors on the Union line occurred. The "B" phase faulted, causing transients on the reactor protection system, which led to a half scram and ESF actuations.**

Form #	Docket	Year	LER #
4-246	260	82	029

Actuation of Fire Suppression Systems Checklist

1. Plant: **Browns Ferry 2** Type: **BWR**

2. Date of Incident: **9/21/82**

3. % Power/Mode? **0%**

4. Initiator? **Pinhole leak in piping**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Due to through-wall pitting corrosion attack, a pinhole leak developed in a 3" fire water supply line to cable tray water spray systems. The hole was repaired and did not affect FPS system operability except during the actual repair work.**

Form #	Docket	Year	LER #
4-247	260	82	030

Actuation of Fire Suppression Systems Checklist

1. Plant: **Browns Ferry 2** Type: **BWR**

2. Date of Incident: **10/6/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Pinhole leak in piping**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **See LER 260/82-029.**

Form #	Docket	Year	LER #
2-32	261	85	020

Actuation of Fire Suppression Systems Checklist

1. Plant: **Robinson 2** Type: **PWR**

2. Date of Incident: **9/11/85**

3. % Power/Mode? **At unspecified power level**

4. Initiator? **Overheating of Main Transformer C**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Main transformer area**

10. Affected plant system(s)? **Electric transmission/distribution**

11. Critical systems? **Yes**

12. Affected equipment? **Main Transformer C control cabinet**

13. Critical equipment? **Yes**

14. Failure mode? **Water spraying into open electrical cabinet, false signals**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Heavy rains and a defective power supply plug caused a breaker trip that resulted in loss of power to the cooling fans on main transformer C. While the main transformer C control cabinet was open for troubleshooting, the main transformer deluge system actuated. Deluge water entering the cabinet generated false signals which caused a turbine and reactor trip. The transformer temperature was over 100RC when the deluge actuated.**

Form #	Docket	Year	LER #
4-280	269	80	036

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oconee 1** Type: **PWR**

2. Date of Incident: **12/9/80**

3. % Power/Mode? **100%**

4. Initiator? **Pressure surge**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent-outside**

8. Components of fire suppression system which failed/initiated actuation? **Temporary hose**

9. Affected area(s) of plant? **Outside yard**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Portions of the fire water system were out of service for excavation. Temporary hoses were utilized to provide fire protection to certain plant areas. Due to system demands, the HPSW pumps were placed into service. Due to the resulting pressure surge, the hoses ruptured. No apparent damage to plant systems or equipment.**

Form #	Docket	Year	LER #
4-291	270	81	019

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oconee 2** Type: **PWR**

2. Date of Incident: **11/24/81**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **Unknown**

13. Critical equipment?

14. Failure mode? **Unknown**

15. Result in a plant transient? **Controlled shutdown**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Construction personnel severed a 2-inch line branching off the water header that supplies the CT-5 transformer fire suppression system. Not clear from the LER the exact location of the leak and what, if any, equipment was wetted or damaged.**

Form #	Docket	Year	LER #
4-297	271	87	008

Actuation of Fire Suppression Systems Checklist

1. Plant: **Vermont Yankee** Type: **BWR**

2. Date of Incident: **8/17/87**

3. % Power/Mode? **0% - refueling**

4. Initiator? **Pressure surge - inadequate design (personnel)**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Temporary PVC piping**

9. Affected area(s) of plant? **Reactor building refueling floor**

10. Affected plant system(s)? **Floor drain system**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **Yes**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Offsite power was lost due to a grid interruption. The EDG's started, followed by 3 pumps. These pumps as well as the diesel pump caused a pressure surge which ruptured a temporary section of 2" schedule 80 PVC piping. About 2,000 gallons of water spilled on the reactor building refueling floor and seeped into numerous areas, contaminating various local areas in the reactor building. No equipment was damaged.**

Form #	Docket	Year	LER #
2-40	272	82	087

Actuation of Fire Suppression Systems Checklist

1. Plant: **Salem 1** Type: **PWR**

2. Date of Incident: **11/9/82**

3. % Power/Mode? **Refueling**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **"Several" deluge systems**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Fuel handling building, auxiliary building, control room**

10. Affected plant system(s)? **Ventilation systems**

11. Critical systems? **No**

12. Affected equipment? **Charcoal filters**

13. Critical equipment? **No**

14. Failure mode? **Wetting of filters**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **For no apparent reason, several deluge systems actuated temporarily. The only damage was the wetting of several charcoal filters in the ventilation systems.**

Form #	Docket	Year	LER #
4-333	272	83	066

Actuation of Fire Suppression Systems Checklist

1. Plant: **Salem 1** Type: **PWR**

2. Date of Incident: **12/25/83**

3. % Power/Mode? **100%**

4. Initiator? **Piping leaks - freezing weather**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping (elbow)**

9. Affected area(s) of plant? **Carpenter shop**

10. Affected plant system(s)? **Fire Protection**

11. Critical systems? **No**

12. Affected equipment? **FPS Tanks**

13. Critical equipment? **No**

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The fire water tank fell below required levels due to fire suppression system leaks. Leaks were caused by freezing weather that led to a ruptured piping elbow and various unspecified system leaks.**

Form #	Docket	Year	LER #
4-336	272	83	069

Actuation of Fire Suppression Systems Checklist

1. Plant: **Salem 1** Type: **PWR**
2. Date of Incident: **12/26/83**
3. % Power/Mode? **75%**
4. Initiator? **Leaking valve - freezing weather**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Valve**
9. Affected area(s) of plant? **"B" building hallway**
10. Affected plant system(s)? **None specified**
11. Critical systems?
12. Affected equipment? **None specified**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Freezing weather ruptured a 4" fire system alarm valve, causing a sudden drop in header pressure. Apparently, no equipment was damaged.**

Form #	Docket	Year	LER #
2-44	277	82	030

Actuation of Fire Suppression Systems Checklist

1. Plant: **Peach Bottom 2** Type: **BWR**

2. Date of Incident: **9/17/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Grinnel Model B valve**

9. Affected area(s) of plant? **Recombiner Building**

10. Affected plant system(s)? **Storm drain system**

11. Critical systems? **No**

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Spurious actuation of a fire suppression valve in the Recombiner Building. Sprinkler water was drained to a floor sump and mixed with radioactive water, causing the sump to overflow. A small quantity of overflowing water escaped the building, contaminating the storm drain system. No equipment was damaged.**

Form #	Docket	Year	LER #
2-46	277	84	013

Actuation of Fire Suppression Systems Checklist

1. Plant: **Peach Bottom 2** Type: **BWR**

2. Date of Incident: **6/29/84**

3. % Power/Mode? **0%**

4. Initiator? **Fire pump testing (leaking elbow)**

5. How many fire suppression systems actuated? **One - leak**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Fire header elbow**

9. Affected area(s) of plant? **Turbine Building Elev. 116'**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While testing the motor driven fire pump, the diesel fire pump automatically started. Control room received reports of flooding at the turbine building 116' elevation. A break occurred in an elbow in the fire header at that location, causing a drop in system pressure and fire pump initiation. Both fire pumps were shutdown and the fire header was isolated for repairs. No damage was reported.**

Form #	Docket	Year	LER #
2-53	281	86	020

Actuation of Fire Suppression Systems Checklist

1. Plant: **Surry 2** Type: **PWR**
2. Date of Incident: **12/9/86**
3. % Power/Mode? **100%**
4. Initiator? **Escaping steam/water**
5. How many fire suppression systems actuated? **One (initially); at least 3**
6. Suppression system(s) involved?

   Water X CO_2: X Halon: X Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Fire protection control panel circuits**
9. Affected area(s) of plant? **Turbine Building, Control Room, Cable Tray Rooms, Emergency Switchgear Rooms**
10. Affected plant system(s)? **CO_2 system, Halon system, radio system, security**
11. Critical systems? **No**
12. Affected equipment? **Control panels for CO_2 and Halon, radio repeater, card reader**
13. Critical equipment? **No**
14. Failure mode? **Water shorted control circuits; CO_2 iced up radio repeater.**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **Yes - followed Unit 2 reactor trip**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Forty seconds after a reactor trip, a main feedwater elbow ruptured, releasing steam and water into the turbine building. This water shorted out the security card readers for all the plant and entered a fire protection control panel through an open conduit, shorting several circuits and actuating 62 sprinkler heads. The sprinkler water leaked into the control panels to the Cable Tray Rooms CO_2 suppression system and for the Emergency Switchgear Rooms Halon suppression systems, shorting control circuits and actuating the CO_2 and Halon systems. The main CO_2 supply tank was emptied, CO_2 and Halon leaked into the control room, and a worker was momentarily trapped between the CO_2, the Halon, and an inoperable security door. CO_2 generated 2 feet of snow in the cable room.**

Form #	Docket	Year	LER #
4-432	285	87	025
2-54	285	87	033

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ft. Calhoun 1** Type: **PWR**
2. Date of Incident: **7/6/87**
3. % Power/Mode? **100%**
4. Initiator? **Inadequate test procedure**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Check valve interfacing between dry pipe system and instrument air system**
9. Affected area(s) of plant? **Auxiliary Building, Diesel Generator Rooms**
10. Affected plant system(s)? **Instrument air system, Diesel Generator**
11. Critical systems? **Yes**
12. Affected equipment? **Diesel Generator Exhaust Damper**
13. Critical equipment? **Yes**
14. Failure mode? **Residue prevents check valves from fully closing; water-borne residue caused pilot valve to stick**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **On July 6, 1987, during a test of the diesel generator dry pipe fire protection system, water entered the instrument air system from the FPS. The cause was foreign material preventing closure of the check valves interfacing between the two systems. An extensive blow down of the instrument air system was performed to remove the water. Subsequently, during a generator test on September 23, 1987, dirt and residue from this contamination of the air system caused an air flow pilot valve for the diesel generator #2 exhaust damper to stick. This caused the diesel generator to overheat and automatically shutdown.**

Form #	Docket	Year	LER #
4-458	289	83	013

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI-1** Type: **PWR**
2. Date of Incident: **4/19/83**
3. % Power/Mode? **0%**
4. Initiator? **Valve leakage**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Safety bleeder valve**
9. Affected area(s) of plant? **Relay room**
10. Affected plant system(s)? **Cardox system**
11. Critical systems? **No**
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **Degraded FPS Operability**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A defective CO_2 system safety bleeder valve is found leaking following system recharging. The seat leakage was significant enough to cause the Cardox unit to drop below its low setpoint pressure. No apparent equipment damage.**

Form #	Docket	Year	LER #
2-58	293	83	011

Actuation of Fire Suppression Systems Checklist

1. Plant: **Pilgrim 1** Type: **BWR**

2. Date of Incident: **2/25/83**

3. % Power/Mode? **Unknown**

4. Initiator? **Incorrect installation of solenoid valve**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Control solenoid valve**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **Standby Gas Treatment System (SBGT)**

11. Critical systems? **No**

12. Affected equipment? **Charcoal filters in B system**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal filters**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Incorrect installation of solenoid valve in deluge system resulted in water leaking into SBGT system charcoal filters.**

Form #	Docket	Year	LER #
4-486	293	83	019

Actuation of Fire Suppression Systems Checklist

1. Plant: **Pilgrim 1** Type: **BWR**

2. Date of Incident: **4/10/83**

3. % Power/Mode? **99%**

4. Initiator? **Severed fire supply pipe - vibration induced fatigue**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Turbine/Generator**

11. Critical systems? **Yes**

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A sprinkler head supply pipe above the turbine stop valves severed, apparently due to vibration-induced fatigue. No plant transient or equipment damage resulted.**

Form #	Docket	Year	LER #
2-62	296	82	001

Actuation of Fire Suppression Systems Checklist

1. Plant: **Browns Ferry 3** Type: **BWR**
2. Date of Incident: **1/14/82**
3. % Power/Mode? **Unknown**
4. Initiator? **Personnel hung coats on spray valve**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Fixed spray valve**
9. Affected area(s) of plant? **Staging area**
10. Affected plant system(s)? **Smoke detection**
11. Critical systems? **No**
12. Affected equipment? **Smoke detector**
13. Critical equipment? **No**
14. Failure mode? **Water in smoke detector**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Personnel hung coats on fire spray valve, causing inadvertent actuation of the water spray. The water reached a smoke detector which then falsely annunciated. The false alarm could have masked any real alarms from other smoke detectors.**

Form #	Docket	Year	LER #
4-540	298	80	006

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cooper** Type: **BWR**

2. Date of Incident: **2/22/80**

3. % Power/Mode? **93%**

4. Initiator? **Failed gasket**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Flow switch gasket**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **RCIC, RHR**

11. Critical systems? **Yes**

12. Affected equipment? **125 VDC Starter racks**

13. Critical equipment? **Yes**

14. Failure mode? **Shorting of MOV starter contact**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While hydrotesting a recently installed fire protection system, a misaligned flow detector gasket failed. Water sprayed into the 125VDC starter racks for RCIC and RHR, shorting a contact for a RCIC system motor operated valve starter, rendering the system inoperable.**

Form #	Docket	Year	LER #
2-64	298	84	007

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cooper** Type: **BWR**
2. Date of Incident: **4/19/84**
3. % Power/Mode? **70%**
4. Initiator? **Personnel error, starting of fire pump**
5. How many fire suppression systems actuated? **Two**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Clappers on deluge valves failed. Also, sheared hydrant**
9. Affected area(s) of plant? **Outside secured area, reactor building**
10. Affected plant system(s)? **Standby Gas Treatment System**
11. Critical systems? **No**
12. Affected equipment? **Charcoal filters**
13. Critical equipment? **No**
14. Failure mode? **Wetting of charcoal filters**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Bulldozer sheared off fire hydrant, automatically starting fire pumps. Fire pumps were shut off until the hydrant leak was isolated, and then were restarted to repressurize the system. Sudden restarting of the electric fire pump generated a system water hammer. The water hammer opened the worn clappers on the automatic deluge valves by the Standby Gas Treatment System. The deluge wetted the charcoal filters on both filter trains. Since the SBGT system was inoperable, the reactor was placed in cold shutdown.**

Form #	Docket	Year	LER #
2-65	301	89	002

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point Beach 2** Type: **PWR**

2. Date of Incident: **3/29/89**

3. % Power/Mode? **100%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Transmission, EDG's**

11. Critical systems? **Yes**

12. Affected equipment? **Unit 2 X01C phase main transformer**

13. Critical equipment? **Yes**

14. Failure mode? **Spray-induced flashover locks out main transformer**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A wiring problem was discovered for a modification which replaced the transformer deluge system heat detectors with new electronic detectors. While troubleshooting, the deluge system was spuriously actuated. A main transformer lockout (spray-induced flashover), main generator breaker trip, and turbine and reactor trips occurred as a result. The emergency diesels also started on bus undervoltage.**

Form #	Docket	Year	LER #
2-66	302	80	016

Actuation of Fire Suppression Systems Checklist

1. Plant: **Crystal River 3** Type: **PWR**

2. Date of Incident: **4/1/80**

3. % Power/Mode? **0%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Auxiliary Building**

10. Affected plant system(s)? **Auxiliary Building ventilation system**

11. Critical systems? **No**

12. Affected equipment? **Exhaust filter (AHFL-2A)**

13. Critical equipment? **No**

14. Failure mode? **Wetting of filters**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While attempting to reset a fire service panel alarm, personnel inadvertently actuated the fire deluge system to the auxiliary building. The deluge wetted one train of the auxiliary building ventilation exhaust filters, requiring replacement.**

Form #	Docket	Year	LER #
4-542	302	82	061

Actuation of Fire Suppression Systems Checklist

1. Plant: **Crystal River 3** Type: **PWR**

2. Date of Incident: **9/29/82**

3. % Power/Mode? **97%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **Reactor Building ventilation**

11. Critical systems? **No**

12. Affected equipment? **Fan damper operator, Instrument air piping**

13. Critical equipment? **No**

14. Failure mode? **Water backed up into instrument air, failed damper operator**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Using incorrect flow diagrams, personnel opened a valve connecting fire water to the instrument air system. Water backed up into the air piping. Though most of it was drained, enough remained to fail a reactor building ventilation fan damper operator. Reduced cooling to the reactor building resulted in temperatures exceeding the 130RF tech. spec. limit.**

Form #	Docket	Year	LER #
2-77	312	87	035

Actuation of Fire Suppression Systems Checklist

1. Plant: **Rancho Seco** Type: **PWR**

2. Date of Incident: **6/25/87**

3. % Power/Mode? **0% (startup)**

4. Initiator? **Test of CO_2 system**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Nuclear service electrical building**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Following a test of the carbon dioxide discharge system in the Nuclear Service Electrical Building, several uncontrolled carbon dioxide discharges occurred. The cause of the uncontrolled discharges is not specified. The area was temporarily abandoned but no equipment was damaged.**

Form #	Docket	Year	LER #
2-81	315	83	001

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 1** Type: **PWR**

2. Date of Incident: **1/18/83**

3. % Power/Mode? **Normal (at power) operation**

4. Initiator? **Probable water in detector**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Unit 1 auxiliary cable vault**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The carbon dioxide system spuriously discharged in the Unit 1 auxiliary cable vault. To stop the discharge, isolation of the CO_2 tank from the entire system (both units) was required until the local isolation valve was located. No reason for the spurious actuation is given (though a similar occurrence for Unit 2 on same date is reported in 316/83-019).**

Form #	Docket	Year	LER #
2-89	315	85	071

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 1** Type: **PWR**

2. Date of Incident: **12/19/85**

3. % Power/Mode? **90%**

4. Initiator? **Personnel error during CO_2 system test**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Auxiliary Building**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a test of the plant carbon dioxide fire protection system, the system was accidentally actuated such that carbon dioxide was discharged. No equipment was damaged, but a fire watch required for another reason at the 573' level of the auxiliary building had to be suspended until the air was cleared.**

Form #	Docket	Year	LER #
3-133	316	82	082

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 2** Type: **PWR**

2. Date of Incident: **10/7/82**

3. % Power/Mode? **100%**

4. Initiator? **Weld leak**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Welded pipe fitting**

9. Affected area(s) of plant? **Auxiliary Building**

10. Affected plant system(s)? **CO_2 system**

11. Critical systems? **No**

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Due to a defective weld, a leak developed in a 4" tee fitting, releasing CO_2 which resulted in loss of CO_2 protection to a portion of the auxiliary building.**

Form #	Docket	Year	LER #
3-135	316	82	089

Actuation of Fire Suppression Systems Checklist

1. Plant: Cook 2 Type: **PWR**

2. Date of Incident: **10/27/82**

3. % Power/Mode? **100%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Automatic (type of actuation unknown)**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Auxiliary cable vault**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Unknown**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **For unknown reasons, an automatic actuation of the fixed CO_2 fire protection system in the auxiliary cable vault occurred. During the actuation, a fire damper failed to close, which is the subject of the LER. It is not known whether the actuation was advertent, inadvertent, or routine FPS testing.**

Form #	Docket	Year	LER #
2-90	316	82	092

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 2** Type: **PWR**

2. Date of Incident: **11/9/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Water in Pyralarm detector**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Pyralarm detector**

9. Affected area(s) of plant? **Auxiliary Cable Vault**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Water from an unknown source entered a Pyralarm detector and caused a false fire annunciation. Carbon dioxide was then inadvertently discharged into the auxiliary cable vault. No equipment was damaged, but isolation of the erroneous alarm also isolated other alarms in the zone.**

Form #	Docket	Year	LER #
2-91	316	83	019

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 2** Type: **PWR**

2. Date of Incident: **1/18/83**

3. % Power/Mode? **Normal (at power) operation**

4. Initiator? **Water in Pyralarm detector**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Pyralarm detector**

9. Affected area(s) of plant? **Auxiliary cable vault**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Similar to event for Unit 1 on same date reported in 315/83-001. Water from an unspecified source entered the base of a Pyralarm detector, causing the detector to alarm. An inadvertent CO_2 discharge into the Unit 2 auxiliary cable vault occurred. Isolation of the erroneous alarm also isolated other alarms in the zone. The source of water was redirected to a drain.**

Form #	Docket	Year	LER #
4-725	316	83	055

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 2** Type: **PWR**

2. Date of Incident: **7/4/83**

3. % Power/Mode? **0%**

4. Initiator? **Leaking valve**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Containment**

10. Affected plant system(s)? **Ventilation**

11. Critical systems? **No**

12. Affected equipment? **Aux. Charcoal Filter Fan**

13. Critical equipment? **No**

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Due to sand in valve seating surfaces, and a packing leak, fire suppression system water flowed into the containment auxiliary charcoal filter fan #2 and was observed coming from the fan drain line.**

Form #	Docket	Year	LER #
2-96	316	85	026

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cook 2** Type: **PWR**

2. Date of Incident: **9/8/85**

3. % Power/Mode? **0%**

4. Initiator? **Leaky valves**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **FPS isolation valves**

9. Affected area(s) of plant? **Unknown (Auxiliary Building?)**

10. Affected plant system(s)? **Filter systems**

11. Critical systems? **No**

12. Affected equipment? **Charcoal absorbers**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Upon routine inspection, charcoal absorber banks were found to be wet. The source of the water was leaking FPS isolation valves. The filters were Unit 1 ACRF, Unit 2 ACRF, and Unit 2 HV-AES-2.**

Form #	Docket	Year	LER #
2-100	320	82	018

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI 2** Type: **PWR**

2. Date of Incident: **6/1/82**

3. % Power/Mode? **0%**

4. Initiator? **Lightning**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Ultraviolet light detector**

9. Affected area(s) of plant? **Air Intake Tunnel, Aux. Building, Fuel Building**

10. Affected plant system(s)? **Aux. and Fuel Building ventilation systems**

11. Critical systems? **No**

12. Affected equipment? **Supply and exhaust fans**

13. Critical equipment? **No**

14. Failure mode? **None - interlocks performed as designed**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Lightning apparently set off an ultraviolet light fire detector which actuated the Air Intake Tunnel Halon system. Actuation of the Halon system then activated the AIT deluge system and tripped the supply and exhaust fans for the auxiliary building and fuel handling building. The deluge activation and fan trips were designed system interlocks. It was 11 days before the Halon system was returned to service.**

Form #	Docket	Year	LER #
2-101	320	82	023

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI 2** Type: **PWR**

2. Date of Incident: **6/29/82**

3. % Power/Mode? **0%**

4. Initiator? **Lightning**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Ultraviolet light detector**

9. Affected area(s) of plant? **Air Intake Tunnel, Auxiliary Building, Fuel Building**

10. Affected plant system(s)? **Auxiliary and Fuel Building ventilation systems**

11. Critical systems? **No**

12. Affected equipment? **Supply and Exhaust Fans**

13. Critical equipment? **No**

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Same as 320/82-018 except the Halon system was out of service for 10 days. Note: The actuations described by 320/82-018, 320/82-023, 320/83-009, and 320/83-014 were all caused by the same ultraviolet light detectors. Furthermore, the bad experience with these detectors caused plant personnel to intentionally disable these detectors on several occasions, as reported in LER's 320/83-025, 320/83-031, and 320/83-043.**

Form #	Docket	Year	LER #
3-160	320	83	004

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI 2** Type: **PWR**

2. Date of Incident: **2/16/83**

3. % Power/Mode? **0%**

4. Initiator? **Failed heat tracing, freezing**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Frozen deluge pipes**

9. Affected area(s) of plant? **Air intake tunnel**

10. Affected plant system(s)? **Halon system**

11. Critical systems? **No**

12. Affected equipment? **Halon system heat detectors**

13. Critical equipment? **No**

14. Failure mode? **Detectors submerged under water**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **On February 16, 1983, routine inspection revealed standing water on the floor of the Air Intake Tunnel. The high water level was due to freeze-induced leaks in the deluge system. The deluge froze because of failed heat tracing on the deluge pipes. Also, two alarms to indicate the high sump level failed to annunciate, allowing 1 or 2 Halon system heat detectors to be submerged.**

Form #	Docket	Year	LER #
4-770	320	83	005

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI 2** Type: **PWR**

2. Date of Incident: **2/14/83**

3. % Power/Mode? **0%**

4. Initiator? **Damaged pipe fittings**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Air intake tunnel**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **Chlorine monitor**

13. Critical equipment? **No**

14. Failure mode? **Leakage from damaged FPS piping freezes on floor; blocks chlorine monitor discharge piping**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Fire deluge system pipe fittings were damaged for unknown reasons, resulting in leakage to the floor of the air intake tunnel. The water froze and blocked the discharge piping for the air intake tunnel chlorine monitor.**

Form #	Docket	Year	LER #
2-102	320	83	009

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI 2** Type: **PWR**

2. Date of Incident: **3/3/83**

3. % Power/Mode? **0%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Air intake tunnel, Aux. Building, Fuel Building**

10. Affected plant system(s)? **Aux. and Fuel Building ventilation systems**

11. Critical systems? **No**

12. Affected equipment? **Supply and exhaust fans**

13. Critical equipment? **No**

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Similar to 320/83-018 and 320/83-023, although the reason for actuation could not be determined. The Halon system was unavailable for 8 days.**

Form #	Docket	Year	LER #
2-103	320	83	014

Actuation of Fire Suppression Systems Checklist

1. Plant: **TMI 2** Type: **PWR**

2. Date of Incident: **5/6/83**

3. % Power/Mode? **0%**

4. Initiator? **Welding activity**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Ultraviolet light detector**

9. Affected area(s) of plant? **Air Intake Tunnel, Auxiliary Building, Fuel Building**

10. Affected plant system(s)? **Auxiliary and Fuel Building ventilation systems**

11. Critical systems? **No**

12. Affected equipment? **Supply and Exhaust Fans**

13. Critical equipment? **No**

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Welding activity near the Air Intake Tunnel actuated an ultraviolet light fire detector. The detector initiated the AIT Halon system, which then triggered the deluge system and tripped the supply and exhaust fans for the auxiliary building and fuel handling building ventilation systems - by design. The Halon system was out of service for 14 days after this event. This event is similar to 320/82-018, 320/82-023, and 320/83-009.**

Form #	Docket	Year	LER #
2-109	321	80	034

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**

2. Date of Incident: **4/3/80**

3. % Power/Mode? **Power Operation (% not specified)**

4. Initiator? **Pressure spike**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Cooling towers - outside**

10. Affected plant system(s)? **Circ. water, fire suppression systems**

11. Critical systems? **No**

12. Affected equipment? **Fire water storage tanks**

13. Critical equipment? **No**

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An apparent water pressure spike tripped the deluge valve at the north end of the 1B cooling tower. A sticking pressure switch prevented proper annunciation. As a result, the fire water tank level fell below tech. spec. limits.**

Form #	Docket	Year	LER #
2-110	321	81	028

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**

2. Date of Incident: **4/7/81**

3. % Power/Mode? **Unknown**

4. Initiator? **System testing**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Cooling Tower "C" - outside**

10. Affected plant system(s)? **FPS systems, Circ. water**

11. Critical systems? **No**

12. Affected equipment? **Fire water storage tanks**

13. Critical equipment? **No**

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a fire pump test, the test valve was opened to measure pump flow. Subsequently, a diesel fire pump overcrank alarm was received and the pump was turned off. Since the test valve was still open, the fire system depressurized, causing the actuation of the Cooling Tower "C" deluge valve. Both fire tanks fell below minimum level requirements. Soon after, the pump was restarted, and the deluge valve was reset.**

Form #	Docket	Year	LER #
4-792	321	81	135

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**
2. Date of Incident: **12/15/81**
3. % Power/Mode? **99%**
4. Initiator? **Pipe rupture**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent-outside**
8. Components of fire suppression system which failed/initiated actuation? **Piping**
9. Affected area(s) of plant? **Outside low voltage switchgard**
10. Affected plant system(s)? **Fire protection systems**
11. Critical systems? **No**
12. Affected equipment? **FPS Storage tanks**
13. Critical equipment? **No**
14. Failure mode? **Degraded FPS Operability**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A ruptured fire main in the Unit 2 low voltage switchyard caused both FPS storage tanks to drop about 70,000 gallons each.**

Form #	Docket	Year	LER #
--	321	82	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**

2. Date of Incident: **11/82**

3. % Power/Mode? **Refueling**

4. Initiator? **Drop in air pressure in detection system**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Compressor Air Pilot-Detection System**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **Unknown**

15. Result in a plant transient? **Unknown**

16. Result of a plant transient? **Unknown**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The loss of an air compressor caused a drop in pressure in the air pilot detection system. This drop actuated an unspecified deluge valve.**

Form #	Docket	Year	LER #
2-113	321	85	018

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**
2. Date of Incident: **5/15/85**
3. % Power/Mode? **100%**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Instrument water valve**
9. Affected area(s) of plant? **Control Room**
10. Affected plant system(s)? **HPCI, Low-low-set safety relief valve, Control Room HVAC**
11. Critical systems? **Yes**
12. Affected equipment? **Analog transmitter trip system panel, HVAC charcoal filters**
13. Critical equipment? **Yes**
14. Failure mode? **Water shorted circuits in ATTS panel; wetted charcoal filters**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Personnel dragged an overhead crane hook on an instrument water supply vent valve, damaging the valve. The loss of pressure in the pipe actuated the deluge for the control room HVAC "A" filter train. The water soaked the "A" charcoal filters and then backed up in the ventilation ducts (because of plugged drains) and sprayed out of a control room vent onto an Analog Transmitter Trip System panel. The water entered the panel and cause the "A" Low-low-set safety relief valve to fail open, caused the HPCI trip solenoid to temporarily energize (rendering HPCI inoperable), and caused the failure of an ATTS power supply. Since the LLS SRV was failed open, the reactor was manually scrammed.**

Form #	Docket	Year	LER #
2-114	321	85	026

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**

2. Date of Incident: **6/27/85**

3. % Power/Mode? **64%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Closing of deluge valve diaphragm chamber water supply valve**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Electrical transmission/distribution**

11. Critical systems? **Yes**

12. Affected equipment? **"1C" startup transformer, A & B 4160 volt busses, reactor recirculation pumps**

13. Critical equipment? **Yes**

14. Failure mode? **Water caused phase-to-ground fault trip on transformer**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Worker closes the wrong valve (deluge valve diaphragm chamber water supply valve), inadvertently actuating the deluge over the "1C" startup transformer. The water caused a phase-to-ground fault which tripped the transformer. The trip resulted in a loss of power to the plant "A" and "B" 4160 volt busses. The "A" and "B" reactor recirculation pumps consequently lose their power source, and the plant was scrammed.**

Form #	Docket	Year	LER #
4-807	321	86	007

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**

2. Date of Incident: **3/11/86**

3. % Power/Mode? **0%- refueling**

4. Initiator? **Failure in deluge valve seat**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Leaking deluge valve**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **Standby Gas Treatment System**

11. Critical systems? **No**

12. Affected equipment? **"1A" charcoal absorbers**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A material failure in the deluge valve seat results in a leak which wetted the charcoal absorbers in the "1A" standby gas treatment system. The leaky valve was replaced on November 24, 1985, but the wet charcoal was not noticed until March 11, 1986.**

Form #	Docket	Year	LER #
3-167	321	87	017

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 1** Type: **BWR**

2. Date of Incident: **10/8/87**

3. % Power/Mode? **100%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Leaking clearance boundary valve**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **Standby Gas Treatment System**

11. Critical systems? **No**

12. Affected equipment? **Carbon filters**

13. Critical equipment? **No**

14. Failure mode? **Wetting of filters**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Numerous personnel errors during FPS maintenance resulted in a leaking clearance boundary valve, which led to wetting the carbon filters in the standby gas treatment system "A" filter train.**

Form #	Docket	Year	LER #
2-125	327	85	046

Actuation of Fire Suppression Systems Checklist

1. Plant: **Sequoyah 1** Type: **PWR**

2. Date of Incident: **11/18/85**

3. % Power/Mode? **0%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Containment fire hose stations**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A high pressure fire protection deluge valve inadvertently opened and charged fire hose stations for the Unit 1 reactor coolant pumps and annulus. It was also discovered that the discharge drain valve on the deluge valve was leaking.**

Form #	Docket	Year	LER #
2-129	327	86	026

Actuation of Fire Suppression Systems Checklist

1. Plant: **Sequoyah 1** Type: **PWR**
2. Date of Incident: **6/29/86**
3. % Power/Mode? **0%**
4. Initiator? **Moisture shorted relay contacts**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Sudden pressure relay failed on transformer**
9. Affected area(s) of plant? **Transformer area**
10. Affected plant system(s)? **Electrical transmission/distribution, diesel generators**
11. Critical systems? **Yes**
12. Affected equipment? **Common station service transformers (CSST) "C" and "D"**
13. Critical equipment? **Yes**
14. Failure mode? **Actuation caused trips of CSST's C & D. Busses did not fail, but were shifted**
15. Result in a plant transient? **No - 0%**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Moisture shorted the contacts on a micro-switch within the sudden pressure relay on common station service transformer (CSST) "D". The short actuated the fire suppression system which sprayed CSST "D" with water. The suppression actuation tripped CSST's "C" and "D" off-line. The transient undervoltage experienced as the busses they were carrying shifted to another CSST caused the automatic starting of the diesel generators. The generators were soon stopped and no equipment damage occurred.**

Form #	Docket	Year	LER #
4-921	331	82	021

Actuation of Fire Suppression Systems Checklist

1. Plant: **Arnold** Type: **BWR**

2. Date of Incident: **3/2/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Leaky valve**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Leaky deluge valve and plugged drain**

9. Affected area(s) of plant? **Reactor Bldg.**

10. Affected plant system(s)? **Standby Gas Treatment System**

11. Critical systems? **No**

12. Affected equipment? **Charcoal bed in "A" train**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During testing, the "A" charcoal bed in the standby gas treatment system was found to be wet. The cause was a leaking deluge valve in combination with a plugged deluge drain line.**

Form #	Docket	Year	LER #
4-922	331	83	011

Actuation of Fire Suppression Systems Checklist

1. Plant: **Arnold** Type: **BWR**
2. Date of Incident: **3/16/83**
3. % Power/Mode? **Unknown**
4. Initiator? **Leaky valve**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Leaking deluge valve and plugged drain line**
9. Affected area(s) of plant? **Reactor Bldg.**
10. Affected plant system(s)? **Standby Gas Treatment System**
11. Critical systems? **No**
12. Affected equipment? **Charcoal bed**
13. Critical equipment? **No**
14. Failure mode? **Wetting of charcoal**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **During inspection, the "B" charcoal bed in the standby gas treatment system was found degraded by water leaking from the deluge system. The drain line contributed by directing the water into the charcoal bed. This event is similar to that reported in LER 331/82-021.**

Form #	Docket	Year	LER #
2-134	331	84	042

Actuation of Fire Suppression Systems Checklist

1. Plant: **Arnold** Type: **BWR**
2. Date of Incident: **11/23/84**
3. % Power/Mode? **81%**
4. Initiator? **Slow leak in pressurized sensing header**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Leaking pressurized sensing header; clogged pressure regulator.**
9. Affected area(s) of plant? **Transformer area**
10. Affected plant system(s)? **Electrical transmission/distribution**
11. Critical systems? **Yes**
12. Affected equipment? **Startup transformer; non-vital electrical busses**
13. Critical equipment? **Yes**
14. Failure mode? **Water shorted out transformer**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A slow leak in a pressurized sensing header surrounding the startup transformer coupled with foreign material clogging the pressure regulator leading to the header caused the deluge system over the startup transformer to actuate. The deluge then caused a short in the startup transformer such that the transformer tripped. This trip resulted in the loss of the non-vital electrical busses, a turbine trip, and a reactor scram.**

Form #	Docket	Year	LER #
2-138	331	86	020

Actuation of Fire Suppression Systems Checklist

1. Plant: **Arnold** Type: **BWR**

2. Date of Incident: **10/15/86**

3. % Power/Mode? **94%**

4. Initiator? **Incorrect test procedure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Open deluge isolation valve**

9. Affected area(s) of plant? **Control Building**

10. Affected plant system(s)? **Standby Filter Units**

11. Critical systems? **No**

12. Affected equipment? **Charcoal beds**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge system for the standby filter units was disconnected from the main deluge system for a test. As part of the test, the deluge isolation valves were commanded open. The test procedure omitted a step to close the isolation valves. Consequently, when the deluge system was restored, the SFU's were sprayed with water, disabling both SFU's.**

Form #	Docket	Year	LER #
2-141	333	86	012

Actuation of Fire Suppression Systems Checklist

1. Plant: **Fitzpatrick** Type: **BWR**

2. Date of Incident: **5/25/86**

3. % Power/Mode? **100%**

4. Initiator? **Faulty test procedure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Unknown (probably Reactor Bldg.)**

10. Affected plant system(s)? **HPCI, Main Steam Line Drain**

11. Critical systems? **Yes**

12. Affected equipment? **Battery Motor Control Center, valve breakers**

13. Critical equipment? **Yes**

14. Failure mode? **Water caused trip of breakers that control valves**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a test of the water spray fire protection system, some of the water drained onto a battery motor control center and into two valve breaker cubicles. The two breakers tripped, rendering the HPCI steam supply valve and the main steam line drain outboard isolation valve inoperable. The main steam line drain valve did not present a safety issue, but the loss of the HPCI valve caused the HPCI system to be inoperable.**

Form #	Docket	Year	LER #
4-941	333	86	021

Actuation of Fire Suppression Systems Checklist

1. Plant: **Fitzpatrick** Type: **BWR**
2. Date of Incident: **12/23/86**
3. % Power/Mode? **82%**
4. Initiator? **Crack in pipe coupling**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Pipe coupling on fire curtain #1 manifold**
9. Affected area(s) of plant? **Unknown (probably Reactor Building)**
10. Affected plant system(s)? **Main steam loss of power monitor**
11. Critical systems? **Yes**
12. Affected equipment? **Battery Motor Control Center #2**
13. Critical equipment? **Yes**
14. Failure mode? **Water short circuited a resistor on loss of power monitor**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A test line coupling on the fire curtain #1 manifold cracked. Water leaking from the crack reached the battery motor control center #2, wetting two rows of breaker cubicles and causing a resistor in the breaker to a main steam line drain valve loss-of-power monitor to fail. The valves controlled by the breakers remained operable until the BMCC was de-energized for repairs. De-energizing the BMCC caused the HPCI system and certain PCIS isolation valves to be temporarily inoperable.**

Form #	Docket	Year	LER #
2-146	336	82	042

Actuation of Fire Suppression Systems Checklist

1. Plant: **Millstone 2** Type: **PWR**

2. Date of Incident: **10/9/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Fire station box pull handle**

9. Affected area(s) of plant? **Plant computer room**

10. Affected plant system(s)? **Plant computer system**

11. Critical systems? **No**

12. Affected equipment? **Plant computer**

13. Critical equipment? **No**

14. Failure mode? **Automatic computer shutdown after Halon actuation**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A construction worker bumped a fire station box pull handle with some construction material, actuating the computer room Halon system. The Halon actuation automatically shut down the plant computer.**

Form #	Docket	Year	LER #
2-155	344	81	016

Actuation of Fire Suppression Systems Checklist

1. Plant: **Trojan** Type: **PWR**

2. Date of Incident: **7/28/81**

3. % Power/Mode? **Unknown**

4. Initiator? **Welding**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Recombiner Building**

10. Affected plant system(s)? **Hydrogen Recombiner system**

11. Critical systems? **No**

12. Affected equipment? **Hydrogen recombiner "B" train control power transformer**

13. Critical equipment? **No**

14. Failure mode? **Water short circuited transformer**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Welding activity actuated the fire deluge system inadvertently. The deluge water short circuited the control power transformer to the hydrogen recombiner "B" train, resulting in the "B" train recombiner becoming inoperable.**

Form #	Docket	Year	LER #
2-156	344	85	002

Actuation of Fire Suppression Systems Checklist

1. Plant: **Trojan** Type: **PWR**

2. Date of Incident: **3/9/85**

3. % Power/Mode? **100%**

4. Initiator? **Broken feedwater pipe (steam)**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown (detectors likely)**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **Yes**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The pressure surge from a turbine trip ruptured an eroded section of the heater drain discharge piping. The escaping 350°F steam-water mixture actuated the fire deluge system in the turbine building. The steam damaged secondary plant equipment in the area and injured one person. The cause of the reactor trip was a turbine trip initiated because of a spurious main turbine bearing high vibration indication.**

Form #	Docket	Year	LER #
4-1129	348	81	029

Actuation of Fire Suppression Systems Checklist

1. Plant: **Farley 1** Type: **PWR**

2. Date of Incident: **5/15/81**

3. % Power/Mode? **100%**

4. Initiator? **Pipe rupture**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent - outside**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Outside low voltage switchyard**

10. Affected plant system(s)? **Fire protection systems**

11. Critical systems? **No**

12. Affected equipment? **Fire water tanks**

13. Critical equipment? **No**

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A ruptured fire main in the Unit 2 low voltage switchyard caused a total drop in fire tank levels of approximately 86,000 gallons.**

Form #	Docket	Year	LER #
2-162	348	81	038

Actuation of Fire Suppression Systems Checklist

1. Plant: **Farley 1** Type: **PWR**
2. Date of Incident: **6/10/81**
3. % Power/Mode? **Unknown**
4. Initiator? **Personnel error - improper maintenance**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Valving-deluge sensing lines**
9. Affected area(s) of plant? **Cooling Tower 2B area - outside**
10. Affected plant system(s)? **Fire protection, Circ. water**
11. Critical systems? **No**
12. Affected equipment? **FPS tanks**
13. Critical equipment? **No**
14. Failure mode? **Fire tanks drop below minimum level**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Improper maintenance and incorrect valving results in a loss of air pressure in the cooling tower 2B deluge system sensing lines. As a result, the deluge system actuated. The only impact was to temporarily lower the water level in the deluge tanks below the requirement.**

Form #	Docket	Year	LER #
2-163	348	81	047

Actuation of Fire Suppression Systems Checklist

1. Plant: **Farley 1** Type: **PWR**

2. Date of Incident: **7/21/81**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error during test**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Test regulator in air pressure system**

9. Affected area(s) of plant? **Cooling Tower 2B area**

10. Affected plant system(s)? **Fire protection, circ. water**

11. Critical systems? **No**

12. Affected equipment? **FPS tanks**

13. Critical equipment? **No**

14. Failure mode? **Fire tanks drop below minimum level**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Inproper performance of a deluge system test procedure resulted in an air pressurization system test regulator in a non-secured position. This allowed the deluge system air pressure to decrease, actuating the cooling tower 2B deluge system. The only impact was a temporary drop in the deluge system water supply (similar to 348/81-038).**

Form #	Docket	Year	LER #
2-164	348	81	070

Actuation of Fire Suppression Systems Checklist

1. Plant: **Farley 1** Type: **PWR**

2. Date of Incident: **10/28/81**

3. % Power/Mode? **Unknown**

4. Initiator? **Unknown - spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Cooling tower 1A area**

10. Affected plant system(s)? **Fire protection, circ. water**

11. Critical systems? **No**

12. Affected equipment? **FPS tanks**

13. Critical equipment? **No**

14. Failure mode? **Fire tanks drop below minimum level**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The cooling tower 1A deluge system spuriously actuated. No conclusive reason for the actuation could be determined. The only impact was a temporary drop in the deluge system water supply (similar to 348/81-038 and 348/81-047).**

Form #	Docket	Year	LER #
2-165	348	82	006

Actuation of Fire Suppression Systems Checklist

1. Plant: **Farley 1** Type: **PWR**
2. Date of Incident: **3/10/82**
3. % Power/Mode? **Unknown**
4. Initiator? **Personnel error during maintenance**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Regulator in deluge air pressurization system**
9. Affected area(s) of plant? **Cooling Tower 1A area**
10. Affected plant system(s)? **Fire protection, circ. water**
11. Critical systems? **No**
12. Affected equipment? **FPS tanks**
13. Critical equipment? **No**
14. Failure mode? **Fire tanks drop below minimum level**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Improper maintenance allowed the pressure to drop in the deluge air pressurization system. This drop actuated the cooling tower 1A deluge. The only impact was a temporary lowering of the water level in the deluge supply tanks. (Similar to 348/81-038, 348/81-047, and 348/81-070).**

Form #	Docket	Year	LER #
2-171	352	85	044

Actuation of Fire Suppression Systems Checklist

1. Plant: **Limerick 1** Type: **BWR**
2. Date of Incident: **4/10/85**
3. % Power/Mode? **3%**
4. Initiator? **Pressure spike in switching ventilation fans**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: X Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Heat detector**
9. Affected area(s) of plant? **Auxiliary Equipment Room, Main Control Room**
10. Affected plant system(s)? **Main control room ventilation**
11. Critical systems? **No**
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None - Halon actuation isolates control room ventilation - by design**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Maintenance workers unintentionally tripped off the auxiliary equipment room "A" supply fan. When the standby "B" supply fan auto started, it generated a pressure spike which set off an overly sensitive heat detector. The heat detector then actuated the Halon discharge into the auxiliary equipment room. This discharge forced the isolation of the main control room ventilation system.**

Form #	Docket	Year	LER #
4-1195	361	82	155

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**

2. Date of Incident: **12/6/82**

3. % Power/Mode? **50%**

4. Initiator? **Leaking valve**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Cable spreading room**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The seating surfaces for a 6" manual FPS shutoff valve were damaged, resulting in leakage. Two fire spray systems for the cable spreading room were declared inoperable.**

Form #	Docket	Year	LER #
2-178	361	83	097

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**
2. Date of Incident: **10/17/83**
3. % Power/Mode? **Mode 1 - Power Ops (% unspecified)**
4. Initiator? **Unknown - spurious**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Control Building north cable riser area**
10. Affected plant system(s)? **None specified**
11. Critical systems?
12. Affected equipment? **None specified**
13. Critical equipment?
14. Failure mode? **N/A**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **The deluge in the control building north cable riser area spuriously actuated. No cause for the actuation could be determined, and no other equipment was affected.**

Form #	Docket	Year	LER #
3-215	361	84	033

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**

2. Date of Incident: **6/16/84**

3. % Power/Mode? **100%**

4. Initiator? **Leaking test valve in fire main**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Ruptured fire main piping**

9. Affected area(s) of plant? **Unit 1 4 KV Switchgear Room**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During pressure testing of a new section of fire main piping, the hydrostatic test boundary valves leaked, pressurizing the entire fire main above the normal operating pressure. A weakened section of the fire main broke, flooding the Unit 1 4 KV switchgear room. No equipment damage, other than the pipe break is described.**

Form #	Docket	Year	LER #
4-1270	366	81	124

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 2** Type: **BWR**

2. Date of Incident: **12/15/81**

3. % Power/Mode? **97%**

4. Initiator? **Pipe rupture**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent - outside**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Low voltage switchyard**

10. Affected plant system(s)? **Fire suppression systems**

11. Critical systems? **No**

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The fire main ruptures in the Unit 2 low voltage switchyard, and is isolated for repair. Fire protection to the east side of Unit 2 was also isolated, rendering fire protection for all of Unit 2 inoperable.**

Form #	Docket	Year	LER #
2-186	366	82	100

Actuation of Fire Suppression Systems Checklist

1. Plant: **Hatch 2** Type: **BWR**
2. Date of Incident: **8/28/82 (8/25/82)**
3. % Power/Mode? **10%**
4. Initiator? **Steam/deluge water damage**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Deluge spray head**
9. Affected area(s) of plant? **RCIC Room**
10. Affected plant system(s)? **RCIC System**
11. Critical systems? **Yes**
12. Affected equipment? **RCIC turbine exhaust diaphragm switches**
13. Critical equipment? **Yes**
14. Failure mode? **High temperature (steam); wetting (deluge water) leading to switch corrosion**
15. Result in a plant transient? **No**
16. Result of a plant transient? **Yes, on 8/25/82**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Following a reactor trip on August 25, 1982, a leaking scram discharge drain valve exposed to full reactor pressure allowed hot water and steam to escape, which eventually emerged in the RCIC room via an uncapped CRW drain. The steam resulted in a sharp increase in RCIC room temperature, and actuated a deluge system spray head, which sprayed the RCIC instrument rack. The combined high temperature, spray environment led to wetting and corrosion of RCIC instrumentation and switches. Specific switch corrosion was discovered during surveillance testing on August 28, 1982.**

Form #	Docket	Year	LER #
2-188	368	89	006

Actuation of Fire Suppression Systems Checklist

1. Plant: **Arkansas Nuclear 2** Type: **PWR**

2. Date of Incident: **4/18/89**

3. % Power/Mode? **100%**

4. Initiator? **Steam line rupture (erosion/corrosion pipe wall thinning)**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Sprinkler fusible heads**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Turbine/Generator**

11. Critical systems? **Yes**

12. Affected equipment? **Turbine control circuits**

13. Critical equipment? **Yes**

14. Failure mode? **Shorting of turbine control circuits**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **Yes**

17. Result of a fire in the associated fire area? No

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A 14" steam extraction line ruptured under the turbine. Steam melted fusible links and actuated the turbine bearing sprinkler system. Firewater shorted turbine control circuits, tripping the turbine, which then caused a reactor trip. The LER details complications with respect to Emergency Feedwater, feedwater control, atmospheric steam dump, and excess RCS cooldown.**

Form #	Docket	Year	LER #
2-195	374	89	007

Actuation of Fire Suppression Systems Checklist

1. Plant: **La Salle 2** Type: **BWR**

2. Date of Incident: **6/12/89**

3. % Power/Mode? **100%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **None known**

9. Affected area(s) of plant? **Transformers**

10. Affected plant system(s)? **Transmission**

11. Critical systems? **Yes**

12. Affected equipment? **System Auxiliary Transformer, Bus 243**

13. Critical equipment? **Yes**

14. Failure mode? **Arc over at the "A" phase bushing from deluge water**

15. Result in a plant transient? **Yes - reduced power level**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge system over the system auxiliary transformer inadvertently actuated for unknown reasons. A fault occurred resulting in transfer of most loads to the unit auxiliary transformer except Bus 243, which required the 2B diesel generator for its power. The transient caused temporary loss of some equipment. Unit 2 remained on-line after the incident at 92% power.**

Form #	Docket	Year	LER #
2-196	382	85	047

Actuation of Fire Suppression Systems Checklist

1. Plant: **Waterford 3** Type: **PWR**

2. Date of Incident: **10/28/85**

3. % Power/Mode? **100%**

4. Initiator? **Steam leak**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Feedwater pump area (Turbine Bldg.)**

10. Affected plant system(s)? **Feedwater**

11. Critical systems? **Yes**

12. Affected equipment? **Main feedwater pump "B" control cabinet**

13. Critical equipment? **Yes**

14. Failure mode? **Water intrusion in pump control cabinet**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A steam leak from the suction flange of the main feedwater pump "B" actuated the deluge system directly above the pump. The deluge water sprayed on and into the pump control cabinet causing the pump to trip. The pump trip resulted in a rapid increase in pressurizer pressure and consequently a reactor trip.**

Form #	Docket	Year	LER #
2-197	387	82	040

Actuation of Fire Suppression Systems Checklist

1. Plant: **Susquehanna 1** Type: **BWR**

2. Date of Incident: **10/18/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Heat sensing thermo-switch**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **Control Room Emergency Operation Air Safety System (CREOASS) Charcoal Bed Train "A"**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A construction worker bumped a deluge system heat sensing thermo-switch, actuating the deluge over the CREOASS "A" train charcoal bed. The "A" train was inoperable until the charcoal was replaced.**

Form #	Docket	Year	LER #
2-201	395	83	098

Actuation of Fire Suppression Systems Checklist

1. Plant: **Summer 1** Type: **PWR**

2. Date of Incident: **8/16/83**

3. % Power/Mode? **Mode 1 Power Ops (% unknown)**

4. Initiator? **Pressure surge during fire pump test**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Auxiliary Building**

10. Affected plant system(s)? **Auxiliary Building ventilation**

11. Critical systems? **No**

12. Affected equipment? **Plenum "B" charcoal filter**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a test of auxiliary building sprinkler system, a pressure surge caused by startup of the electric fire pump tripped open a deluge valve. This actuated the deluge system over the auxiliary building charcoal exhaust filter plenum "B," wetting the charcoal.**

Form #	Docket	Year	LER #
2-203	397	84	026

Actuation of Fire Suppression Systems Checklist

1. Plant: **WPPSS 2** Type: **BWR**

2. Date of Incident: **3/21/84, 4/19/84, 4/27/84**

3. % Power/Mode? **1% (startup)**

4. Initiator? **Pressure transients in the fire water system**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Sensitive deluge valve**

9. Affected area(s) of plant? **Reactor Bldg.**

10. Affected plant system(s)? **Standby Gas Treatment System**

11. Critical systems? **No**

12. Affected equipment? **Charcoal filters in "B" train**

13. Critical equipment? **No**

14. Failure mode? **None - charcoal not adversely impacted**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **On three occasions between March 21, 1984, and April 27, 1984, water was found in the SBGT system "B" train. The water came from the deluge system which was believed to have been actuated by pressure transients in the deluge water system. On each occasion, a charcoal test cannister was analyzed, and the charcoal was found to be still operable.**

Form #	Docket	Year	LER #
2-204	397	84	096

Actuation of Fire Suppression Systems Checklist

1. Plant: **WPPSS 2** Type: **BWR**
2. Date of Incident: **9/1/84**
3. % Power/Mode? **65%**
4. Initiator? **Steam leak**
5. How many fire suppression systems actuated? **Three**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown (heat detectors?)**
9. Affected area(s) of plant? **Turbine Building, Diesel Generator Building, Water Filtration Building**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **N/A**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A steam leak in the turbine building actuated the deluge system nearby. The leak also tripped the pre-action valves in two diesel generator building dry pipe systems. As a result of the deluge actuation the diesel fire pump was started. Five minutes later, the fire pump trouble alarm annunciated. The deluge and dry pipe systems were secured, but shortly thereafter, a fire alarm in the water filtration building went off. It turned out that the diesel fire pump coolant valve had been closed so that the pump had been running without coolant. The pump had generated smoke in the water filtration building.**

Form #	Docket	Year	LER #
2-206	400	89	006

Actuation of Fire Suppression Systems Checklist

1. Plant: **Shearon Harris 1** Type: **PWR**
2. Date of Incident: **3/14/89**
3. % Power/Mode? **100%**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**
9. Affected area(s) of plant? **Turbine Bldg.**
10. Affected plant system(s)? **Main feedwater**
11. Critical systems? **Yes**
12. Affected equipment? **"B" MFP motor junction box**
13. Critical equipment? **Yes**
14. Failure mode? **Internal short due to water spray intrusion**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **While attempting to "resettle" the fire system deluge valve, water was sprayed on the "B" MFP. Water entered the motor junction box via gaps in the motor enclosure, causing an internal short that blew the junction box cover off. The reactor tripped on low steam generator level.**

Form #	Docket	Year	LER #
4-1685	423	86	054

Actuation of Fire Suppression Systems Checklist

1. Plant: **Millstone 3** Type: **PWR**

2. Date of Incident: **10/30/86**

3. % Power/Mode? **100%**

4. Initiator? **Excavation damage**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent - outside**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **yard**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A fire water ring header valve ruptured due to excavation damage. The header was isolated and repaired and fire watches were established. The fire watch for containment was not established in the 1-hour limit due to containment access restrictions.**

Form #	Docket	Year	LER #
2-236	423	87	032

Actuation of Fire Suppression Systems Checklist

1. Plant: **Millstone 3** Type: **PWR**

2. Date of Incident: **7/6/87**

3. % Power/Mode? **100%**

4. Initiator? **Incorrect test procedure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Fire detection system panel**

9. Affected area(s) of plant? **East MCC/Rod Control Area**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a test of the zone modules in the fire detection system panels, the carbon dioxide system in the east MCC/Rod Control Area was inadvertently actuated. This actuation was due to the omission from the test procedure of the proper reset steps. The affected area had to be evacuated.**

Form #	Docket	Year	LER #
2-237	424	88	016

Actuation of Fire Suppression Systems Checklist

1. Plant: **Vogtle 1** Type: **PWR**
2. Date of Incident: **6/3/88**
3. % Power/Mode? **100%**
4. Initiator? **Smoke from electric duct heater**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Leaky preaction valve leakoff lines**
9. Affected area(s) of plant? **Upper cable spreading room; control room**
10. Affected plant system(s)? **Reactor coolant system**
11. Critical systems? **Yes**
12. Affected equipment? **Process panels in control room**
13. Critical equipment? **Yes**
14. Failure mode? **Water in electrical panels caused spurious signals**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Smoke from an electric duct heater actuated smoke detectors. The sprinkler heads did not actuate, but water ran from the preaction valve leakoff lines into the upper cable spreading room and onto the control room ceiling. Since the control room ceiling was not adequately water tight, water seeped into the control room and entered some process panels. The water in the panels caused the spurious actuation of reactor coolant system equipment. Control room personnel promptly corrected the coolant system configuration.**

Form #	Docket	Year	LER #
4-1716	454	87	005

Actuation of Fire Suppression Systems Checklist

1. Plant: **Byron 1** Type: **PWR**

2. Date of Incident: **3/10/87**

3. % Power/Mode? **0%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Sprinkler head**

9. Affected area(s) of plant? **Auxiliary Building**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Contractor personnel damaged and activated an FPS sprinkler head while moving equipment in the auxiliary building stairway. The stairway separates areas containing redundant safety equipment.**

Form #	Docket	Year	LER #
2-239	454	87	011

Actuation of Fire Suppression Systems Checklist

1. Plant: **Byron 1** Type: **PWR**
2. Date of Incident: **4/15/87**
3. % Power/Mode? **0%**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: X Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Diesel driven Auxiliary Feedwater Pump Room**
10. Affected plant system(s)? **Auxiliary feedwater**
11. Critical systems? **Yes**
12. Affected equipment? **Not specified**
13. Critical equipment?
14. Failure mode? **Unknown**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **An inadvertent discharge of the CO_2 system occurred on April 4, 1987. No LER was referenced or found to detail this discharge. This LER reports on the closure of the vapor pilot valve, which rendered the system inoperable.**

Form #	Docket	Year	LER #
2-240	456	87	048

Actuation of Fire Suppression Systems Checklist

1. Plant: **Braidwood 1** Type: **PWR**

2. Date of Incident: **9/11/87**

3. % Power/Mode? **0%**

4. Initiator? **Personnel/procedural error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Auxiliary drain valve mispositioned**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Transmission**

11. Critical systems? **Yes**

12. Affected equipment? **System auxiliary transformers**

13. Critical equipment? **Yes**

14. Failure mode? **Auxiliary transformers tripped, loss of offsite power**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During deluge system surveillance, an inadvertent actuation occurred, tripping both system auxiliary transformers. The actuation was due to a mispositioned auxiliary drain valve. Loss of offsite power resulted, and all Engineered Safety Feature Systems operated as designed.**

Form #	Docket	Year	LER #
2-241	456	87	050

Actuation of Fire Suppression Systems Checklist

1. Plant: **Braidwood 1** Type: **PWR**
2. Date of Incident: **9/23/87**
3. % Power/Mode? **38%**
4. Initiator? **Maintenance procedures**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Deluge test valve**
9. Affected area(s) of plant? **Transformer area**
10. Affected plant system(s)? **Electric transmission/distribution**
11. Critical systems? **Yes**
12. Affected equipment? **Unit auxiliary transformers**
13. Critical equipment? **Yes**
14. Failure mode? **Deluge activated lock out relay, isolating transformers**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Maintenance personnel were reinstalling the handle on a transformer deluge alarm test valve. Since the deluge system had not been isolated before the maintenance work, when the workers inadvertently turned the valve stem, it actuated the deluge system over a unit auxiliary transformer. The deluge actuation then activated the eighty-six lockout relay, electrically isolating both unit auxiliary transformers. This isolation led to a turbine trip and a reactor trip.**

Form #	Docket	Year	LER #
2-242	458	86	005

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**
2. Date of Incident: **1/7/86**
3. % Power/Mode? **3% (startup)**
4. Initiator? **Personnel error - construction worker**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Solenoid activation switch**
9. Affected area(s) of plant? **Unknown**
10. Affected plant system(s)? **Electric distribution**
11. Critical systems? **Yes**
12. Affected equipment? **Motor Control Centers, Load Center, Transformer**
13. Critical equipment? **Yes**
14. Failure mode? **Water shorted load center**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A construction worker thought a water curtain solenoid activation switch was a door latch and inadvertently actuated the water curtain. The water ran into two nearby motor control centers, through a floor penetration, and into a load center on the floor below. The water caused a short in the load center, and the short burned up a transformer. The burnt transformer then tripped the breaker feeding that load center and two other load centers. The loss of these three load centers caused a reactor trip.**

Form #	Docket	Year	LER #
2-243	458	86	039

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**
2. Date of Incident: **5/19/86**
3. % Power/Mode? **73%**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Turbine Building**
10. Affected plant system(s)? **Main turbine**
11. Critical systems? **Yes**
12. Affected equipment? **Turbine bearing vibration sensor**
13. Critical equipment? **No**
14. Failure mode? **Water in sensor cable connector causes false trip signal**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **The deluge system was inadvertently actuated over the main turbine bearings. About 7 hours later, water that had accumulated in the #3 bearing vibration probe cable connector generated a false high vibration signal. This signal caused the closure of the turbine stop valves and a reactor scram.**

Form #	Docket	Year	LER #
2-249	483	85	011

Actuation of Fire Suppression Systems Checklist

1. Plant: **Callaway 1** Type: **PWR**
2. Date of Incident: **2/22/85**
3. % Power/Mode? **1% (startup)**
4. Initiator? **Leaky deluge system**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Leaking hand pull station**
9. Affected area(s) of plant? **Transformer area**
10. Affected plant system(s)? **Electric transmission/distribution**
11. Critical systems? **Yes**
12. Affected equipment? **Startup transformer, control rod drive motors**
13. Critical equipment? **Yes**
14. Failure mode? **Deluge interlock tripped startup transformer**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Deluge system water leaked into the deluge system hand pull station for the startup transformer. The transformer interlock circuit interpreted this leakage as a deluge actuation and tripped off the startup transformer. Consequently, power was lost to the control rod drive motors and the reactor was manually tripped.**

Form #	Docket	Year	LER #
2-252	499	89	001

Actuation of Fire Suppression Systems Checklist

1. Plant: **South Texas 2** Type: **PWR**

2. Date of Incident: **1/6/89**

3. % Power/Mode? **0%**

4. Initiator? **Inadequate procedures for system restoration**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **None**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Transmission**

11. Critical systems? Yes

12. Affected equipment? **Standby transformer**

13. Critical equipment? **Yes**

14. Failure mode? **Ground fault of phase B bushing**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Due to lack of procedures for deluge system restoration following thermal detector replacement, an inadvertent actuation occurred over the standby transformer. A phase B bushing fault lead to a partial loss of offsite power, which required diesel generators to reenergize the B and C trains.**

Form #	Docket	Year	LER #
2-255	528	86	043

Actuation of Fire Suppression Systems Checklist

1. Plant: **Palo Verde 1** Type: **PWR**

2. Date of Incident: **6/19/86 (4/28/86)**

3. % Power/Mode? **100%**

4. Initiator? **Cleaning activity - personnel**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Auxiliary Bldg. - Low Pressure SI Pump Room**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The train "B" low pressure safety injection pump room was being decontaminated on April 28, 1986, when the deluge valve began spuriously actuating. As a result, personnel then took the sprinkler system valves out of service and instituted an hourly fire watch. On June 19, 1986, the NRC determined that the fire watch was not being conducted properly. Apparently, no other equipment was affected.**

Form #	Docket	Year	LER #
4-1795	**528**	**88**	**005**

Actuation of Fire Suppression Systems Checklist

1. Plant: **Palo Verde 1** Type: **PWR**

2. Date of Incident: **1/23/88**

3. % Power/Mode? **0%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent - outside**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Outside protected area**

10. Affected plant system(s)? **Fire protection systems**

11. Critical systems? **No**

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **Degraded FPS Operability**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A backhoe operator damaged a post indication valve causing fire water to spray in the Unit 1 protected area. Personnel error and procedural deficiency resulted in difficulties while isolating the leak, rendering fire protection for other plant areas inoperable.**

Form #	Docket	Year	LER #
20	244	80	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **10/24/80**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Transformers**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 1100 and fire brigade responded. Upon arrival it was determined that the main transformer deluge system had activated with no sign of smoke or fire. System restored to operable status.**

Form #	Docket	Year	LER #
21	244	80	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **10/25/80**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Transformers**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 0310 and fire brigade responded. Upon arrival it was determined that the main transformer deluge system had activated with no sign of smoke or fire. System restored to operable status.**

Form #	Docket	Year	LER #
19	244	81	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **11/26/81**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 2322 and fire brigade responded. Upon brigade arrival it was determined that the main transformer deluge system had actuated with no sign of smoke or fire. System restored to operable status.**

Form #	Docket	Year	LER #
18	244	81	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **11/30/81**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 2156 and fire brigade responded. Upon arrival it was determined that the main transformer deluge system had activated with no signs of smoke or fire. System restored to operable status.**

Form #	Docket	Year	LER #
15	244	84	--

Actuation of Fire Suppression Systems Checklist

1. Plant: Ginna Type: PWR

2. Date of Incident: 3/6/84

3. % Power/Mode? Not operating

4. Initiator? Unknown

5. How many fire suppression systems actuated? 1

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? Inadvertent

8. Components of fire suppression system which failed/initiated actuation? Detection devices

9. Affected area(s) of plant? Other cable area

10. Affected plant system(s)? None

11. Critical systems?

12. Affected equipment? None

13. Critical equipment?

14. Failure mode? N/A

15. Result in a plant transient? No

16. Result of a plant transient? No

17. Result of a fire in the associated fire area? No

18. Result of an internal fire elsewhere? No

19. Result of a fire external to the plant? No

20. Summary of Incident: Alarm announced @ 1655 and fire brigade responded. Upon brigade arrival it was determined that the cable tunnel deluge system had actuated from a welding and grinding area in an adjacent area. No sign of smoke or fire. System restored to operable status.

Form #	Docket	Year	LER #
16	244	84	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **3/8/84**

3. % Power/Mode? **Not operating**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Other cable areas**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 1846 and fire brigade responded. Upon brigade arrival it was determined that the cable tunnel deluge system had actuated from dust as workers were working on the moisture separators/reheaters. No sign of fire or smoke. System restored to operable status.**

Form #	Docket	Year	LER #
12	244	88	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **11/4/88**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation device**

9. Affected area(s) of plant? **Other cable areas**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 1039 and fire brigade responded. Upon brigade arrival it was determined that a person doing an electrical upgrade inspection in the cable tunnel hit a manual actuator. No sign of smoke or fire. Area secured and system restored to operable status.**

Form #	Docket	Year	LER #
11	244	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**
2. Date of Incident: **2/18/89**
3. % Power/Mode? **Unknown**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **1**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Transformers**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **N/A**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Alarm announced @ 2312 and fire brigade responded. Upon brigade arrival it was noted that the deluge system was spraying down the main transformer. No sign of smoke or fire. Deluge system was restored to operable status.**

Form #	Docket	Year	LER #
9	244	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna** Type: **PWR**

2. Date of Incident: **8/30/89**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **FPS Valve**

9. Affected area(s) of plant? **Misc. Service areas**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Alarm announced @ 2330 and fire brigade responded. Upon brigade arrival it was determined that the deluge valve had actuated by cleaning personnel who tripped system control valve and there was not sign of fire. Deluge system was restored to service.**

Form #	Docket	Year	LER #
142	280	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Surry 1** Type: **PWR**

2. Date of Incident: **3/23/89**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Steam**

5. How many fire suppression systems actuated? **2**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Electronic panel**

9. Affected area(s) of plant? **Switchgear rooms**

10. Affected plant system(s)? **Fire protection**

11. Critical systems? **Yes**

12. Affected equipment? **Solenoids in Halon system control panel**

13. Critical equipment? **No**

14. Failure mode? **Water damage to control panel**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **Yes**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Pipe failure occurred on LP heater drain pump resulting in steam release. One sprinkler operated control panel resulting in agent release to emergency switchgear room. Plant power was rolled back but not to cold shutdown.**

Form #	Docket	Year	LER #
145	352	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Limerick 1** Type: **BWR**
2. Date of Incident: **8/1/89**
3. % Power/Mode? **Unknown**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **1**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Reactor Bldg.**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **Electrical panel**
13. Critical equipment? **Unknown**
14. Failure mode? **Wetting**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **System actuated - wetted an electrical panel. No shorts or electrical faults occurred.**

Form #	Docket	Year	LER #
143	352	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Limerick 1** Type: **BWR**

2. Date of Incident: **12/1/89**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Reactor Bldg.**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Human error - tested wrong heat detector during performance of a unit 1 ST.**

Form #	Docket	Year	LER #
144	352	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Limerick 1** Type: **BWR**
2. Date of Incident: **12/1/89**
3. % Power/Mode? **Unknown**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **1**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Detection devices**
9. Affected area(s) of plant? **Office areas (TSC)**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Initiation occurred in the technical support center which is an out structure. The cause is uncertain but probably due to faulty smoke detectors.**

Form #	Docket	Year	LER #
160	458	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**

2. Date of Incident: **6/5/89**

3. % Power/Mode? **Not operating**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Transformers**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Deluge system protecting a preferred station services transformer spuriously activated. The transformer was not energized at time of trip and no damage was reported.**

Form #	Docket	Year	LER #
153	548	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**

2. Date of Incident: **6/13/89**

3. % Power/Mode? **Not operating**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Transformers**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Deluge system protecting a preferred station services transformer spuriously activated. The transformer was not energized at time of trip and no damage was reported.**

Form #	Docket	Year	LER #
147	458	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**
2. Date of Incident: **10/3/89**
3. % Power/Mode? **Operating (unspecified)**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **1**
6. Suppression system(s) involved?

   Water X CO$_2$: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Turbine Bldg**
10. Affected plant system(s)? **Turbine lube oil**
11. Critical systems? **No**
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Deluge system protecting turbine lube oil system spuriously actuated. The sprinkler system was shut off with no damage reported.**

Form #	Docket	Year	LER #
146	458	89	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**

2. Date of Incident: **11/29/89**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Other cable area**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Deluge system protecting a pipe/electrical tunnel was activated by plant personnel during system checkout of a trouble condition in one of the cross zoned detection circuits. Both detection zones were inadvertently placed in the alarm condition and the system actuated as designed.**

Appendix A.2

Advertent FPS Actuations

Form #	Docket	Year	LER #
1-1	029	84	013

Actuation of Fire Suppression Systems Checklist

1. Plant: **Yankee Rowe** Type: **PWR**

2. Date of Incident: **8/2/84**

3. % Power/Mode? **100% (Mode 1)**

4. Initiator? **Fault, and arc, in ACB**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Fire detection**

9. Affected area(s) of plant? **4-1 bus area**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **Controlled plant shutdown**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes, elec. arcing**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Due to high resistance caused by contact retainer ring failure in a 480 volt ACB, a fault and electrical arc propagation triggered 4-1 bus isolation, fire detection initiation, and Halon discharge. A controlled plant shutdown was initiated for repairs.**

Form #	Docket	Year	LER #
1-15	219	82	010

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oyster Creek** Type: **BWR**
2. Date of Incident: **2/18/82**
3. % Power/Mode? **Apparently shutdown**
4. Initiator? **Smoke from overheated bearing**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Advertent**
8. Components of fire suppression system which failed/initiated actuation? **Detector**
9. Affected area(s) of plant? **Reactor Bldg. 51' elevation**
10. Affected plant system(s)? **Core spray; RPS, containment isolation**
11. Critical systems? **Yes**
12. Affected equipment? **Instrument rack RK02; panel switches**
13. Critical equipment? **Yes**
14. Failure mode? **Wetting of switches**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **Yes, smoke**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Cleanup pump motor bearing overheats actuating reactor bldg. deluge system. Inadequate electrical sealing results in wetting of instrument rack switches, adversely impacting plant safety systems and equipment.**

Form #	Docket	Year	LER #
2-38	271	89	012

Actuation of Fire Suppression Systems Checklist

1. Plant: **Vermont Yankee** Type: **BWR**
2. Date of Incident: **3/3/89**
3. % Power/Mode? **0% - refueling**
4. Initiator? **Pump motor ground fault - ionized dust particles**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Advertent**
8. Components of fire suppression system which failed/initiated actuation? **Detectors**
9. Affected area(s) of plant? **West switchgear room**
10. Affected plant system(s)? **Control room toxic gas monitoring system**
11. Critical systems? **No**
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **CO_2 leaks past fire doors; trips gas monitoring system**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **When a ground fault occurred in the "B" service water pump motor circuitry, ionized dust particles resulted which tripped the switch gear room CO_2 fire suppression system. Defective latches in fire barrier doors allowed CO_2 to enter the control room ventilation inlet, which initiated the control room toxic gas monitoring system. No fire was involved.**

Form #	Docket	Year	LER #
1-111	280	84	027

Actuation of Fire Suppression Systems Checklist

1. Plant: **Surry 1** Type: **PWR**
2. Date of Incident: **12/18/84**
3. % Power/Mode? **0%**
4. Initiator? **Fire - leaking fitting**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Advertent**
8. Components of fire suppression system which failed/initiated actuation? **Manual actuation**
9. Affected area(s) of plant? **#3 Emergency Diesel Generator Room**
10. Affected plant system(s)? **EDG system**
11. Critical systems? **Yes**
12. Affected equipment? **Diesel generator**
13. Critical equipment? **Yes**
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **Yes**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A leaking fitting in the fuel injector line dilutes the lube oil to the turbo charger thrust bearings. Bearing failure causes crankcase explosion and fire. The fixed low pressure CO_2 system activates to extinguish the fire, and the engine was shutdown from its surveillance test run and repaired.**

Form #	Docket	Year	LER #
1-145	295	82	025

Actuation of Fire Suppression Systems Checklist

1. Plant: **Zion 1** Type: **PWR**

2. Date of Incident: **8/11/82**

3. % Power/Mode? **100%**

4. Initiator? **Lube oil fire - vibration**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation**

9. Affected area(s) of plant? **Emergency Diesel Room**

10. Affected plant system(s)? **Emergency Diesel Generator System**

11. Critical systems? **Yes**

12. Affected equipment? **Diesel Generator**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Controlled plant ramp down**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While diesel generator was being tested, the turbocharger lube oil filter mounting screw vibrated loose, allowing lube oil to spray past an O-ring seal onto the exhaust manifold. The lube oil flashed, the engine was shutdown, and the room Cardox system was actuated. As too many diesels were inoperable, a controlled unit shutdown was commenced.**

Form #	Docket	Year	LER #
1-175	312	84	015

Actuation of Fire Suppression Systems Checklist

1. Plant: **Rancho Seco** Type: **PWR**

2. Date of Incident: **3/19/84**

3. % Power/Mode? **85%**

4. Initiator? **Hydrogen explosion and fire**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Turbine Bldg.**

10. Affected plant system(s)? **Turbine/Generator**

11. Critical systems? **Yes**

12. Affected equipment? **Generator**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes: turbine trip, leading to scram**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Seal oil system problems required manual operator intervention. Inadequate tank level control allowed hydrogen to escape from the main generator, resulting in an explosion and fire. The CO_2 system actuated to extinguish the fire, the turbine was manually tripped, and the reactor tripped.**

Form #	Docket	Year	LER #
1-235	331	84	040

Actuation of Fire Suppression Systems Checklist

1. Plant: **Arnold** Type: **BWR**

2. Date of Incident: **11/4/84**

3. % Power/Mode? **56%**

4. Initiator? **Transformer explosion and fire**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Electrical distribution**

11. Critical systems? **Yes**

12. Affected equipment? **Auxiliary transformer, startup transformer**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The main auxiliary transformer exploded and burned, resulting in loss of power to non-essential busses, a main turbine trip, reactor scram, and damage to and tripping of the adjacent startup transformer. Deluge systems for both transformers initiated. HPCI and RCIC were started to recover reactor coolant level.**

Form #	Docket	Year	LER #
1-256	339	81	055

Actuation of Fire Suppression Systems Checklist

1. Plant: **North Anna 2** Type: **PWR**

2. Date of Incident: **7/3/81**

3. % Power/Mode? **18%**

4. Initiator? **Transformer oil release and fire**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Main transformer bays**

10. Affected plant system(s)? **Electrical distribution**

11. Critical systems? **Yes**

12. Affected equipment? **Main transformers**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An internal fault in the "B" phase main transformer ruptured the side of the transformer. The resulting oil spray and fire exceeded the capability of the A and B phase deluge systems and required extensive fire fighting efforts. The event caused a reactor scram, loss of the 2J emergency bus, spurious ECCS actuation, and other complications.**

Form #	Docket	Year	LER #
1-260	341	86	026

Actuation of Fire Suppression Systems Checklist

1. Plant: **Fermi 2** Type: **BWR**
2. Date of Incident: **8/6/86**
3. % Power/Mode? **1%**
4. Initiator? **Fire in safety-related MCC**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: X Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent - delayed**
8. Components of fire suppression system which failed/initiated actuation? **Detectors**
9. Affected area(s) of plant? **Auxiliary Building, Elevation 683**
10. Affected plant system(s)? **HPCI**
11. Critical systems? **Yes**
12. Affected equipment? **MCC for HPCI valves**
13. Critical equipment? **Yes**
14. Failure mode? **None**
15. Result in a plant transient? **Controlled shutdown initiated after 2 hours**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **Yes**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Due to a wiring error, a fire erupted in a safety-related MCC for 3 HPCI valves, following testing of the HPCI system. Initially the fire was manually extinguished. Smoke evidently initiated the fixed CO_2 suppression system which then fully extinguished the fire.**

Form #	Docket	Year	LER #
1-297	361	85	046

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**

2. Date of Incident: **9/12/85**

3. % Power/Mode? **100%**

4. Initiator? **Fire in generator brush assembly enclosure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation**

9. Affected area(s) of plant? **Turbine Building at main generator**

10. Affected plant system(s)? **Turbine generator**

11. Critical systems? **Yes**

12. Affected equipment? **Generator**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Due to loss of vacuum, oil migrated from the generator bearing assembly housing past the slip rings to the brush assembly. Excessive brush wear resulted in a rapid buildup of carbon dust, which then ignited due to a ground fault. The fire was extinguished in 30 minutes by a combined effort of the fire department and the area Cardox system. The Cardox system was partially ineffective due to damage from the fire prior to reestablishment of its operability to help control the fire.**

Form #	Docket	Year	LER #
1-301	362	85	013

Actuation of Fire Suppression Systems Checklist

1. Plant: San Onofre 3 Type: PWR
2. Date of Incident: 4/8/85
3. % Power/Mode? 100%
4. Initiator? Hydrogen ignition
5. How many fire suppression systems actuated? One
6. Suppression system(s) involved? Unspecified-CO_2 likely

   Water ___ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? Advertent
8. Components of fire suppression system which failed/initiated actuation? Detectors
9. Affected area(s) of plant? Turbine Building
10. Affected plant system(s)? Turbine/Generator
11. Critical systems? Yes
12. Affected equipment? Hydrogen seal oil system
13. Critical equipment? Yes
14. Failure mode? None
15. Result in a plant transient? Yes
16. Result of a plant transient? No
17. Result of a fire in the associated fire area? Yes
18. Result of an internal fire elsewhere? No
19. Result of a fire external to the plant? No
20. Summary of Incident: A vibration-induced pipe fitting failure in the generator hydrogen seal oil system leads to hydrogen leakage and ignition. The area automatic fire suppression system actuated to suppress the fire. The turbine tripped on low seal oil pressure, leading to RPS actuation and a reactor trip.

Form #	Docket	Year	LER #
1-380	416	83	126

Actuation of Fire Suppression Systems Checklist

1. Plant: **Grand Gulf 1** Type: **BWR**

2. Date of Incident: **9/4/83**

3. % Power/Mode? **Unknown**

4. Initiator? **Diesel fuel fire**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve-manual**

9. Affected area(s) of plant? **Diesel Generator Room**

10. Affected plant system(s)? **Emergency Diesel Generator System**

11. Critical systems? **Yes**

12. Affected equipment? **Diesel Generator**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Diesel generator fire resulted from a ruptured fuel line. When the deluge valve failed to open, a mechanic forced it open to extinguish the fire. The fuel line crack was fatigue related. The deluge valve mating surfaces were smoothed and restored to service.**

Form #	Docket	Year	LER #
1-410	482	87	048

Actuation of Fire Suppression Systems Checklist

1. Plant: **Wolf Creek 1** Type: **PWR**
2. Date of Incident: **10/14/87**
3. % Power/Mode? **0%**
4. Initiator? **Fire in Emergency Switchgear Room**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: X Other: ___
7. Advertent or Inadvertent Actuation? **Advertent**
8. Components of fire suppression system which failed/initiated actuation? **Detectors**
9. Affected area(s) of plant? **Emergency switchgear room**
10. Affected plant system(s)? **ESF busses**
11. Critical systems? **Yes**
12. Affected equipment? **Emergency switchgear and busses**
13. Critical equipment? **Yes**
14. Failure mode? **None**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **Yes**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A fatality occurs when a electrician came in contact with an energized portion of the 4160 volt ESF "B" bus. His sleeve caught fire, actuating the Halon system. Subsequent operator action resulted in loss of the RHR system and automatic actuation of the "A" diesel generator.**

Form #	Docket	Year	LER #
1-416	498	89	005

Actuation of Fire Suppression Systems Checklist

1. Plant: **South Texas 1** Type: **PWR**

2. Date of Incident: **1/20/89**

3. % Power/Mode? **100%**

4. Initiator? **Loss of generator hydrogen cooling, bearing fire**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Turbine Generator**

11. Critical systems? **Yes**

12. Affected equipment? **Turbine Bearing**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A loose temperature sensor connection caused loss of generator hydrogen cooling, generator bearing seal leakage, high bearing temperature/vibration, and a fire at bearing 9. The deluge system was actuated, the turbine was manually tripped and the reactor scrammed.**

Form #	Docket	Year	LER #
1-421	528	88	010

Actuation of Fire Suppression Systems Checklist

1. Plant: **Palo Verde 1** Type: **PWR**

2. Date of Incident: **7/6/88**

3. % Power/Mode? **100%**

4. Initiator? **Unit auxiliary transformer rupture and fire**

5. How many fire suppression systems actuated? **Multiple - 4**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Both**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation of deluge for all transformers**

9. Affected area(s) of plant? **Main transformer area**

10. Affected plant system(s)? **Electrical distribution; ESF transformers**

11. Critical systems? **Yes**

12. Affected equipment? **All transformers**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes (due to fires)**

16. Result of a plant transient? **No (actuated due to fires, personnel panic)**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The unit auxiliary transformer ruptured, resulting in a large oil fire. The deluge systems for all of the transformers were manually actuated, and the fire was eventually extinguished by fire protection personnel. A second fire subsequently occurred in the 1E-NAN-S02 bus 13.8 KV switchgear. It was manually extinguished. The reactor tripped on low DNBR due to loss of power to the reactor coolant pumps.**

Form #	Docket	Year	LER #
17	244	83	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ginna 1** Type: **PWR**
2. Date of Incident: **2/25/83**
3. % Power/Mode? **Operating (unspecified)**
4. Initiator? **Fire**
5. How many fire suppression systems actuated? **1**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other: ___
7. Advertent or Inadvertent Actuation? **Advertent**
8. Components of fire suppression system which failed/initiated actuation? **Detection devices**
9. Affected area(s) of plant? **Computer room**
10. Affected plant system(s)? **Plant Computer**
11. Critical systems? **No**
12. Affected equipment? **Backup transformer burned**
13. Critical equipment? **No**
14. Failure mode? **N/A**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **Yes**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Alarm announced @ 1820 and brigade responded. Upon brigade arrival it was determined the smoke in the relay room was caused by a fire in the plant computer's back up transformer. Second alarm was initiated causing halon system to discharge. Area secured and system restored to operable status.**

Form #	Docket	Year	LER #
159	458	88	--

Actuation of Fire Suppression Systems Checklist

1. Plant: **River Bend 1** Type: **BWR**

2. Date of Incident: **9/6/88**

3. % Power/Mode? **Operating (unspecified)**

4. Initiator? **Arcing (animal intrusion)**

5. How many fire suppression systems actuated? **1**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Detection devices**

9. Affected area(s) of plant? **Transformers**

10. Affected plant system(s)? **Transmission**

11. Critical systems? **Yes**

12. Affected equipment? **Transformer & deluge system**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes (arcing)**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Animal (cat) got across two phases of a station main services transformer causing arcing which caused a main generator trip and reactor scram.**

Appendix A.3

FPS Actuations Prior to
Initial Criticality

Form #	Docket	Year	LER #
2-117	322	86	037

Actuation of Fire Suppression Systems Checklist

1. Plant: **Shoreham** Type: **BWR**
2. Date of Incident: **9/8/86**
3. % Power/Mode? **0% - pre-initial criticality**
4. Initiator? **Improper maintenance procedure**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **CO_2 master control valve, CO_2 selector control valve**
9. Affected area(s) of plant? **Normal switchgear room (Turbine Building); Control Building**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **N/A**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **An improper maintenance procedure resulted in the loss of power to the carbon dioxide master control valve. The master control valve opened, admitting carbon dioxide to the selector control valve for the normal switchgear room. The selector control valve was open slightly because of 2 screws wedged into the valve seat. This slight opening allowed carbon dioxide to be released into the normal switchgear room. The control building and normal switchgear room were evacuated for 1 hour.**

Form #	Docket	Year	LER #
2-118	322	89	008

Actuation of Fire Suppression Systems Checklist

1. Plant: **Shoreham** Type: **BWR**

2. Date of Incident: **10/16/89**

3. % Power/Mode? **0% - pre critical**

4. Initiator? **Tampering/sabotage**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve, piping**

9. Affected area(s) of plant? **Reactor Building 8'**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **Electrical junction boxes**

13. Critical equipment? **Yes**

14. Failure mode? **Pipe break, wetting of junction boxes**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An apparent deliberate actuation of a manual pull station in the reactor building causes an inadvertent deluge valve actuation and, subsequently, a pipe break in the fire water header. Electrical junction boxes were wetted internally.**

Form #	Docket	Year	LER #
2-175	361	82	001

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**

2. Date of Incident: **2/14/82**

3. % Power/Mode? **0% (fuel loading) pre-critical**

4. Initiator? **Personnel error during maintenance**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge isolation valve**

9. Affected area(s) of plant? **Control room**

10. Affected plant system(s)? **Control room emergency air cleanup system**

11. Critical systems? **No**

12. Affected equipment? **Charcoal filters**

13. Critical equipment? **No**

14. Failure mode? **Wetting of charcoal in primary system**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During installation of deluge fire protection system, an operator opened the deluge isolation valve which, since the local deluge valve had already been tripped open, actuated the deluge over the control room emergency air cleanup system charcoal filters. The saturated charcoal filters required replacement.**

Form #	Docket	Year	LER #
2-176	361	82	007

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**

2. Date of Incident: **3/3/82**

3. % Power/Mode? **0% (pre-critical)**

4. Initiator? **Personnel error during maintenance**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Spray system block valve**

9. Affected area(s) of plant? **Cable riser shaft**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **Cable tray fire retardant barrier**

13. Critical equipment? **No**

14. Failure mode? **Water damage to barrier material**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a maintenance procedure, personnel misunderstood spray system block valve status and began maintenance on a manual switch while the block valve was still open. As a result, the cable riser shaft water spray was inadvertently actuated. The water damaged the cable tray fire retardant barrier material.**

Form #	Docket	Year	LER #
2-177	361	82	023

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 2** Type: **PWR**

2. Date of Incident: **6/8/82**

3. % Power/Mode? **0% (pre-critical)**

4. Initiator? **Unknown manual actuation**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Deluge valve**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **For some undetermined reason, manual actuation of a deluge valve occurred, inadvertently activating water spray and sprinkler systems. The affected area was not specified. No equipment was damaged.**

Form #	Docket	Year	LER #
2-179	362	83	030

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 3** Type: **PWR**

2. Date of Incident: **2/24/83**

3. % Power/Mode? **0% (Mode 5 - precritical)**

4. Initiator? **Unknown - spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown (fire detector?)**

9. Affected area(s) of plant? **Cable Tunnel Section 10**

10. Affected plant system(s)? **Fire protection**

11. Critical systems? **No**

12. Affected equipment? **Deluge panel internals**

13. Critical equipment? **No**

14. Failure mode? **Corrosion due to water intrusion found 5/11/83**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge spray in cable tunnel section 10 spuriously actuated. The cause was unknown, although construction activity in the area probably was a contributor. It took 10 days to restore the "actuating fire detector." Corrosion to a deluge panel likely resulted from this incident, as reported in LER 362/83-038.**

Form #	Docket	Year	LER #
2-180	362	83	031

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 3** Type: **PWR**

2. Date of Incident: **2/22/83**

3. % Power/Mode? **0% (Mode 5 - pre-critical)**

4. Initiator? **Unknown - spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown (fire detector?)**

9. Affected area(s) of plant? **Diesel Generator Area**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The sprinkler over the diesel generator (#G-002) spuriously actuated. No reason for the actuation could be determined. It took 3 days to restore the fire detector.**

Form #	Docket	Year	LER #
2-181	362	83	033

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 3** Type: **PWR**

2. Date of Incident: **3/31/83**

3. % Power/Mode? **0% (Mode 5 pre-critical)**

4. Initiator? **Unknown - spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown (fire detector?)**

9. Affected area(s) of plant? **Control Building cable riser 30' elev.**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge spray in the control building cable riser 30' elevation spuriously actuated. No reason for the actuation could be found. It was 30 days before the associated fire detectors were restored to service.**

Form #	Docket	Year	LER #
2-182	362	83	035

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 3** Type: **PWR**

2. Date of Incident: **4/4/83**

3. % Power/Mode? **0% (Mode 5 pre-critical)**

4. Initiator? **Unknown - spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown (detectors?)**

9. Affected area(s) of plant? **Radwaste Building cable gallery**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The fire spray system that protects the radwaste building cable gallery spuriously actuated. No cause for the actuation could be found. The associated fire detectors were out of service for 12 days.**

Form #	Docket	Year	LER #
2-183	362	83	047

Actuation of Fire Suppression Systems Checklist

1. Plant: **San Onofre 3** Type: **PWR**

2. Date of Incident: **7/28/83**

3. % Power/Mode? **0% (Mode 4 pre-critical)**

4. Initiator? **Maintenance activity**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation trip lever**

9. Affected area(s) of plant? **Zone 68 (?)**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During cable tray cleaning, a worker accidentally pulled a deluge manual actuation trip lever. This inadvertently actuated the deluge system in Zone 68.**

Form #	Docket	Year	LER #
2-190	369	81	110

Actuation of Fire Suppression Systems Checklist

1. Plant: **McGuire 1** Type: **PWR**

2. Date of Incident: **7/6/81**

3. % Power/Mode? **0% (pre-critical)**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Reserve switch OFF push button**

9. Affected area(s) of plant? **Aux Feedwater Pump room (Turbine Building)**

10. Affected plant system(s)? **None specified**

11. Critical systems?

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Following preventive maintenance/periodic testing on the main and reserve Halon cylinders, the main cylinder was made operable. When attempting to place the reserve into service, the RESERVE ON push button was depressed instead of the ABORT ON to release the OFF button which was stuck. An inadvertent release of the reserve Halon bottle into the auxiliary feedwater pump room resulted.**

Form #	Docket	Year	LER #
2-209	416	82	014

Actuation of Fire Suppression Systems Checklist

1. Plant: **Grand Gulf 1** Type: **BWR**

2. Date of Incident: **7/13/82**

3. % Power/Mode? **0% (pre-critical)**

4. Initiator? **Faulty relay**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Supervisory Relay**

9. Affected area(s) of plant? **Auxiliary Building**

10. Affected plant system(s)? **Auxiliary Building ventilation**

11. Critical systems? **No**

12. Affected equipment? **Fire door**

13. Critical equipment? **No**

14. Failure mode? **CO_2 required auxiliary bldg. evacuation; blew open fire door**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A faulty fire suppression system supervisory relay actuated the CO_2 discharge system in the Emergency Core Cooling System penetration room in the auxiliary building. Since the room did not have proper venting, the CO_2 pressure built up and blew open the locked door. This released CO_2 into the rest of the building, forcing evacuation of the whole auxiliary building.**

APPENDIX B

FOREIGN DATA

This Appendix provides a sampling of historical data for fire protection system actuations in nuclear power plants located primarily in Europe and Canada. Due to resource and schedule limitations, this data was necessarily incomplete. Statements provided in the original submittals were quite clear regarding the lack of documented reports for many incidents, and that data was insufficient for generation of full event abstracts. Efforts to gather additional event data and reactor operating year documentation continue. It is expected that the final report will provide a more comprehensive set of data on foreign FPS actuations.

The appendix is divided into three parts:

a. Appendix B.1 provides summary checklists for 53 events in ten countries that were provided in two submittals from the Oak Ridge Nuclear Operations Analysis Center.

b. Appendix B.2 includes checklists for 16 event summaries provided for Canadian reactors.

c. Appendix B.3 includes a listing of 47 title abstracts of foreign events for which little detail was available.

Appendix B.1

FPS Actuation Data

Events in Ten Foreign Countries

Form #	Docket	Year	LER #
1-1	57-563		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oskarshamn 3 (Sweden)** Type: **BWR**

2. Date of Incident: **12/16/87**

3. % Power/Mode? **100%**

4. Initiator? **Maintenance Error**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant? **N/A**

10. Affected plant system(s)? **Fire Protection**

11. Critical systems?

12. Affected equipment? **Fire Water Pump Diesels**

13. Critical equipment?

14. Failure mode? **Disconnected batteries rendered diesels inoperable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An incorrect maintenance procedure caused the batteries for the fire water pump diesels to be erroneously disconnected. Therefore, the diesels would have not started on demand. No fire or FPS actuation was involved.**

Form #	Docket	Year	LER #
1-2	61-471		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Maanshan 1 (Taiwan)** Type: **PWR**
2. Date of Incident: **9/24/88**
3. % Power/Mode? **75%**
4. Initiator? **Flashover at transformer**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent-Outside**
8. Components of fire suppression system which failed/initiated actuation? **Fire hydrant flange**
9. Affected area(s) of plant? **Outside area**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **Water hammer caused flange break**
15. Result in a plant transient? **No**
16. Result of a plant transient? **Yes**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Vaporized water accumulated below an auxiliary transformer caused a flashover of ceramic insulators. A turbine trip and reactor scram followed; with one control rod failing to fully insert. The fire protection pumps started and a resulting water hammer broke a fire hydrant flange, releasing a large quantity of water. No equipment damage was noted.**

Form #	Docket	Year	LER #
1-3	61-122		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Chin-Shan 2 (Taiwan)** Type: **BWR**

2. Date of Incident: **9/22/89**

3. % Power/Mode? **100%**

4. Initiator? **FPS controller failure**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: X (foam)

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Controller**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **Reactor**

11. Critical systems? **Yes**

12. Affected equipment? **Recirc Pump M/G-sets**

13. Critical equipment? **Yes**

14. Failure mode? **Wetting of equipment leads to equipment trips**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A foam water spray system over the motor generator sets for the recirculating pumps was activated by a controller malfunction. The MG sets tripped (due to wetting) and the reactor was manually shutdown.**

Form #	Docket	Year	LER #
1-5	57-663		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ringhals 3 (Sweden)** Type: **PWR**

2. Date of Incident: **10/21/86**

3. % Power/Mode? **99%**

4. Initiator? **Human error**

5. How many fire suppression systems actuated? **"Several"**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: _X_ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Several unspecified areas**

10. Affected plant system(s)? **Steam Generator Water Side**

11. Critical systems? **Yes**

12. Affected equipment? **Steam Generator Level Regulator**

13. Critical equipment? **Yes**

14. Failure mode? **Moisture spray/intrusion**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During fire surveillance system testing, water and Halon fire protection systems in several areas were actuated. Water spray or moisture intrusion caused loss of a steam generator level regulator, causing low steam generator level and a reactor scram.**

Form #	Docket	Year	LER #
1-6	07-772		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Tihange 2 (Belgium)** Type: **PWR**

2. Date of Incident: **5/9/86**

3. % Power/Mode? **100%**

4. Initiator? **Unknown-spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Control Rod Drive System**

11. Critical systems? **Yes**

12. Affected equipment? **Electrical Connection Box**

13. Critical equipment? **Yes**

14. Failure mode? **Water spray causes erroneous CRD position indications**

15. Result in a plant transient? **Unknown**

16. Result of a plant transient? **Possibly**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The main turbine tripped during overspeed protection system testing. No definite connection was established to a subsequent water spray actuation on the operating floor. A primary pump was sprayed, without consequences, and an electrical connection box associated with the CRD system was wetted. Erroneous CRD position indications resulted. No mention of any further plant transient effects.**

Form #	Docket	Year	LER #
1-7	67-041		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Armenia 1 (USSR)** Type: **PWR**
2. Date of Incident: **10/15/82**
3. % Power/Mode? **100%**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **Unknown**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Unknown**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Reactor Building**
10. Affected plant system(s)?
11. Critical systems?
12. Affected equipment?
13. Critical equipment?
14. Failure mode?
15. Result in a plant transient?
16. Result of a plant transient?
17. Result of a fire in the associated fire area?
18. Result of an internal fire elsewhere?
19. Result of a fire external to the plant?
20. Summary of Incident: **A short circuit in the power cable for the circulating water pump motor resulted in a fire which propagated to a nearly control panel. Loss of process parameters and spurious component operation resulted. The reactor was manually scrammed. No mention was made of fire suppression methods, whether manual, automatic, or both.**

Form #	Docket	Year	LER #
1-9	59-072		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Beznau 2 (Switzerland)** Type: **PWR**

2. Date of Incident: **3/10/87**

3. % Power/Mode? **100%**

4. Initiator? **Electrical ground, small fire, smoke**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: X Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Reactor containment**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None-fire**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A ground short, loose part, or loose contact opened the feed breaker to the containment recirculation pumps. A small fire in the cabling generated sufficient smoke to actuate Halon system detectors and Halon release. No equipment damage was reported, including the cabling.**

Form #	Docket	Year	LER #
1-10	69-633		

Actuation of Fire Suppression Systems Checklist

1. Plant: KRB C2 (W. Germany) Type: BWR

2. Date of Incident: 6/1/87

3. % Power/Mode? 60%

4. Initiator? Hydrogen-Oxygen explosion

5. How many fire suppression systems actuated? None

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? N/A

8. Components of fire suppression system which failed/initiated actuation? N/A

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: During testing, an ADS-SRV failed to close, causing high suppression pool temperature, a reactor scram, HPCI actuation. This event did not involve fires or FPS actuations.

Form #	Docket	Year	LER #
1-11	69-091		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Brunsbuettel 1 (W. Germany)** Type: **BWR**

2. Date of Incident: **7/30/86**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error, fire**

5. How many fire suppression systems actuated? **None, manual suppression**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A fire occurred during cooling water line coating removal. It was first suppressed with a portable extinguisher, which failed. Suppression was completed with a fire hose. No auto FPS actuation occurred. No equipment damage was reported.**

Form #	Docket	Year	LER #
1-12	61-121		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Chin-Shan 1 (Taiwan)** Type: **BWR**

2. Date of Incident: **3/31/87**

3. % Power/Mode? **100%**

4. Initiator? **Pipe leak**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Cable room**

10. Affected plant system(s)? **Unknown**

11. Critical systems?

12. Affected equipment? **Wiring panel**

13. Critical equipment? Unknown

14. Failure mode? **Water leaked into conduct to a wiring panel - wetting**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During preparations for pressure testing various portions of a water fire protection system, the portion in the electrical cable room leaked. Water flowed into an electrical conduit and down into a wiring panel.**

Form #	Docket	Year	LER #
1-13	61-121		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Chin-Shan 1 (Taiwan)** Type: **BWR**

2. Date of Incident: **3/11/87**

3. % Power/Mode? **100%**

4. Initiator? **Valve rupture**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **Unknown**

11. Critical systems?

12. Affected equipment? **Instrument panel**

13. Critical equipment? Unknown

14. Failure mode? **Water shorting in instrument panel**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During flushing operations following FPS piping hydro testing, a valve ruptured. Water sprayed into an instrument panel causing shorts which resulted in a reactor scram.**

Form #	Docket	Year	LER #
1-14	61-122		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Chin-Shan 2 (Taiwan)** Type: **BWR**

2. Date of Incident: **5/9/87**

3. % Power/Mode? **99%**

4. Initiator? **Weld leak**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Diesel Generator Room**

10. Affected plant system(s)? **Diesel Generator System**

11. Critical systems? **Yes**

12. Affected equipment? **Voltage regulator**

13. Critical equipment? Yes

14. Failure mode? **Water intrusion renders EDG inoperable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During FPS pipe flushing operations, water leaked out of welds that had not yet been hydro tested or flushed. The water leaked onto a diesel generator voltage regulator, rendering the system inoperable.**

Form #	Docket	Year	LER #
1-15	57-663		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ringhals 3 (Sweden)** Type: **PWR**

2. Date of Incident: **10/17/86**

3. % Power/Mode? **100%**

4. Initiator? **Operator error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Circuit board**

9. Affected area(s) of plant? **Turbine Building, Diesel Generator, Computer Room**

10. Affected plant system(s)? **Steam Generator Level Control**

11. Critical systems? **Yes**

12. Affected equipment? **Breaker**

13. Critical equipment? **Yes**

14. Failure mode? **Water tripped breaker, loss of SG level**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Following FPS testing, an operator attempted to reset a number of signals. His zipper contacted a control circuit board, which actuated the fire protection system. Water sprayed on the turbine, some cable trays, and the plant computer. A breaker was tripped by the FPS actuation, resulting in loss of steam generator level control and a reactor scram.**

Form #	Docket	Year	LER #
1-16	69-281		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Grafenrheinfeld KKG 1 (W. Germany)** Type: **PWR**

2. Date of Incident: **5/30/86**

3. % Power/Mode? **Unknown**

4. Initiator? **Electric Arc**

5. How many fire suppression systems actuated? **None, manual**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **An electric arc between buses resulted in a fire and smoke; the fire took 33 minutes to extinguish using CO_2 extinguishers.**

Form #	Docket	Year	LER #
1-17	61-471		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Maanshan 1 (Taiwan)** Type: **PWR**

2. Date of Incident: **1/24/87**

3. % Power/Mode? **100%**

4. Initiator? **Leaking valve**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Control Room**

10. Affected plant system(s)? **Solid State Protection System (SSPS)**

11. Critical systems? **Yes**

12. Affected equipment? **SSPS Cabinet**

13. Critical equipment? **Yes**

14. Failure mode? **Water in cabinet**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An FPS valve leak allowed water to flow into cables under the control room floor. The water penetrated the SSPS cabinet, causing a reactor scram, turbine trip, and safety injection system actuation, plus diesel generator and RHR pump starts.**

Form #	Docket	Year	LER #
1-18	57-071		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Barseback 1 (Sweden)** Type: **BWR**

2. Date of Incident: **9/22/86**

3. % Power/Mode? **0%**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Actuation pin**

9. Affected area(s) of plant? **Turbine area**

10. Affected plant system(s)? **Turbine/generators (Emergency power system)**

11. Critical systems? **Yes**

12. Affected equipment? **Gas turbine**

13. Critical equipment? **Yes**

14. Failure mode? **CO_2 release blocked turbine start**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A pin that prevents the release of CO_2 was unintentionally removed. During plant startup, CO_2 was released in the generator area, blocking gas turbine operation for the emergency power system.**

Form #	Docket	Year	LER #
1-19	57-071		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Barseback 1 (Sweden)** Type: **BWR**

2. Date of Incident: **8/14/86**

3. % Power/Mode? **0%**

4. Initiator? **Personnel Error**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **Both fire protection pumps were unavailable when one was being repaired and power was removed from the other. No fire or FPS release was involved.**

Form #	Docket	Year	LER #
1-20	57-241		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Forsmark 1 (Sweden)** Type: **BWR**

2. Date of Incident: **4/26/86**

3. % Power/Mode? **100%**

4. Initiator? **Lightning**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A lightning strike caused an overvoltage in numerous fire alarms, rendering them inoperable. No fire or FPS actuation was involved.**

Form #	Docket	Year	LER #
1-21	61-410		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Kuosheng (Taiwan)** Type: **BWR**
2. Date of Incident: **4/29/86**
3. % Power/Mode? **Unknown**
4. Initiator? **Installation error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Unknown - not specified**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Cable spreading room, control room**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **An unspecified CO_2 system release into the cable spreading room resulted in CO_2 leakage past unsealed penetrations into the main control room.**

Form #	Docket	Year	LER #
1-22	55-121		
1-25	55-121		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cofrentes 1 (Spain)** Type: **BWR**

2. Date of Incident: **2/5/85**

3. % Power/Mode? **77%**

4. Initiator? **Human error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Cable room, control room**

10. Affected plant system(s)? **Unknown**

11. Critical systems?

12. Affected equipment? **Control room panels, components**

13. Critical equipment? **Yes**

14. Failure mode? **Water damage, shorting in panels**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Cleaning personnel used the FPS trip line for cleaning purposes. This depressurized the FPS actuation valve, causing it to open and flood the cable room. Water leaked into the control room below through nonwaterproof cable penetration seals which were not installed correctly. The water penetrated a number of panels causing spurious alarms, power interrupts, and a reactor scram. Component replacement was required in 4 panels.**

Form #	Docket	Year	LER #
1-23	69-941		

Actuation of Fire Suppression Systems Checklist

1. Plant: **KWW 1 (W. Germany)** Type: **BWR**
2. Date of Incident: **8/21/85**
3. % Power/Mode? **Unknown**
4. Initiator? **Oil leak and fire**
5. How many fire suppression systems actuated? **None, manual**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **N/A**
8. Components of fire suppression system which failed/initiated actuation? **N/A**
9. Affected area(s) of plant? **Turbine Building**
10. Affected plant system(s)?
11. Critical systems?
12. Affected equipment?
13. Critical equipment?
14. Failure mode?
15. Result in a plant transient?
16. Result of a plant transient?
17. Result of a fire in the associated fire area?
18. Result of an internal fire elsewhere?
19. Result of a fire external to the plant?
20. Summary of Incident: **An earlier oil leak soaked insulation in the turbine and a fire erupted. It was detected by area smoke detectors and manually extinguished. No auto FPS actuation occurred.**

Form #	Docket	Year	LER #
1-24	21-452		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Loviisa 2 (Finland)** Type: **PWR**

2. Date of Incident: **8/1/85**

3. % Power/Mode? **0%**

4. Initiator? **Fire due to diesel exhaust pipe**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant? **Diesel Generator Building**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A diesel generator exhaust pipe set fire to the roofing around the pipe. The fire was manually suppressed (no FPS actuation occurred).**

Form #	Docket	Year	LER #
1-27	23-552		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Paluel 2 (France)** Type: **PWR**

2. Date of Incident: **8/21/84**

3. % Power/Mode? **Unknown**

4. Initiator? **Oil leak, fire**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Manual actuation**

9. Affected area(s) of plant? **Reactor Building**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **N/A**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An oil leak from improperly installed flanges for the reactor coolant pump startup lube oil pump ignited against the cold leg piping under insulation. An overhead fire protection system was manually actuated to extinguish the fire. No other damage was noted.**

Form #	Docket	Year	LER #
1-28	21-451		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Loviisa 1 (Finland)** Type: **PWR**

2. Date of Incident: **9/6/84**

3. % Power/Mode? **N/A**

4. Initiator? **Transformer fire**

5. How many fire suppression systems actuated? **Unknown**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Unknown**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient? **Unknown**

16. Result of a plant transient? **Unknown**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A 6-hour fire occurred due to the failure and oil spillage (22,000 gallons) of a 400 kV national grid transformer (not at Loviisa). No mention is made of suppression means or FPS activity. This event spurred consideration of modifications at Loviisa.**

Form #	Docket	Year	LER #
1-29	23-154		
1-31	23-154		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Chinon B1 (France)** Type: **PWR**

2. Date of Incident: **3/25/83**

3. % Power/Mode? **75%**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **Unknown**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Unknown**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **Due to a design error, the hydrogen dryer in the generator hydrogen cooling system caught on fire and exploded after a hydrogen leak developed. Too many detectors in series in one line prevented a fire alarm due to undervoltage when all of them were simultaneously challenged. The fire detection system thus failed. No mention is made of the means used for fire suppression or of any fixed FPS actuation.**

Form #	Docket	Year	LER #
1-30	07-163		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Doel 3 (Belgium)** Type: **PWR**

2. Date of Incident: **4/29/83**

3. % Power/Mode? **100%**

4. Initiator? **Design error**

5. How many fire suppression systems actuated? **Five**

6. Suppression system(s) involved?

   Water X CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valves**

9. Affected area(s) of plant? **Diesel Generator Building**

10. Affected plant system(s)? **Diesel Emergency Power, Auxiliary systems (turbine)**

11. Critical systems? **Yes**

12. Affected equipment? **Diesel Generators, Control Board**

13. Critical equipment? **Yes**

14. Failure mode? **Water caused trip signals to diesels, auxiliary systems**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During maintenance on the instrument air system, the air supply to the diesel generator area sprinkler valves was lost. The valves opened for three safety diesels and two non-safety diesels. A control board near one diesel gave a trip signal to a diesel generator and auxiliary systems associated with the turbine, causing a turbine trip.**

Form #	Docket	Year	LER #
1-32	69-911		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Kruemmel KKK 1 (W. Germany)** Type: **BWR**

2. Date of Incident: **11/9/83**

3. % Power/Mode? **Unknown**

4. Initiator? **Vibration**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A vibration induced valve flange failure released steam in an unspecified area of the plant. The building temperature increased, water level in the condensed steam heating tank decreased, radioactivity increased, and fire alarms activated. No fire or FPS actuations occurred, however.**

Form #	Docket	Year	LER #
1-33	57-661		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ringhals 1 (Sweden)** Type: **BWR**

2. Date of Incident: **3/30/84**

3. % Power/Mode? **100%**

4. Initiator? **Design error**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A PRA fire/flood analysis determined that ground faults in nonsafety-related systems could degrade certain safety related systems. This report involves no fire or FPS actuations.**

Form #	Docket	Year	LER #
1-34	57-663		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Ringhals 3 (Sweden)** Type: **PWR**

2. Date of Incident: **1/24/83**

3. % Power/Mode? **40%**

4. Initiator? **Ruptured Strainer, Steam**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Sprinkler heads**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Turbine/Generator**

11. Critical systems? **Yes**

12. Affected equipment? **Generator**

13. Critical equipment? **Yes**

14. Failure mode? **Increasing moisture prompted trip**

15. Result in a plant transient? **Yes**

16. Result of a plant transient? **Yes**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **After sudden load reduction and increase, a condensate pump suction strainer ruptured, causing actuation of fire protection sprinklers. The generator, cables, and other electrical and instrument cubicles were wetted by the steam jet and fire spray water, prompting a manual reactor trip.**

Form #	Docket	Year	LER #
1-35	69-271		

Actuation of Fire Suppression Systems Checklist

1. Plant: GKN 1 (W. Germany) Type: PWR

2. Date of Incident: 4/14/76

3. % Power/Mode? Unknown

4. Initiator? Personnel error

5. How many fire suppression systems actuated? None

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? N/A

8. Components of fire suppression system which failed/initiated actuation? N/A

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: During cable tray modification work, a two inch thick cable to the safety injection pump was cut with a saw. The SI pump tripped on over current during accumulator filling operations, a diesel generator started, and a fire alarm actuated. No fire or FPS actuation resulted.

Form #	Docket	Year	LER #
1-36	57-561		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Oskarshamn 1 (Sweden)** Type: **BWR**
2. Date of Incident: **2/18/82**
3. % Power/Mode? **Unknown**
4. Initiator? **Fire**
5. How many fire suppression systems actuated? **Possibly One - Unknown**
6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Unknown**
8. Components of fire suppression system which failed/initiated actuation? **Possible manual actuation**
9. Affected area(s) of plant? **Turbine Building**
10. Affected plant system(s)?
11. Critical systems?
12. Affected equipment?
13. Critical equipment?
14. Failure mode?
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **Yes**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **An oil leak penetrating steam line insulation at the main turbine ignited. The turbine and reactor were manually tripped and the fire was extinguished using CO_2. It is not clear whether a fixed CO_2 system was actuated, or whether portable CO_2 extinguishers were used.**

Form #	Docket	Year	LER #
1-37	23-031		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Blayais 1 (France)** Type: **PWR**

2. Date of Incident: **5/13/81**

3. % Power/Mode? **0%**

4. Initiator? **Fire, operator errors**

5. How many fire suppression systems actuated? **Unknown**

6. Suppression system(s) involved? **Unknown**

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Fuel Building**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A fire in the fuel building ventilation system erupted and destroyed most of the system. No mention is made of any fire suppression activity, either manual or via fixed fire systems.**

Form #	Docket	Year	LER #
1-38	23-271		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Fessenheim 1 (France)** Type: **PWR**

2. Date of Incident: **6/26/81**

3. % Power/Mode? **0%**

4. Initiator? **Fire-oil or fuel line leakage**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant? **Diesel Generator room**

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **During full-load diesel generator requalification, a fire occurred possibly due to oil or fuel line leakage. The fire was manually extinguished.**

Form #	Docket	Year	LER #
1-39	23-831		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Tricastin 1 (France)** Type: **PWR**

2. Date of Incident: **12/31/79**

3. % Power/Mode? **Unknown**

4. Initiator? **Fire-oil leak**

5. How many fire suppression systems actuated? **None**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **N/A**

8. Components of fire suppression system which failed/initiated actuation? **N/A**

9. Affected area(s) of plant?

10. Affected plant system(s)?

11. Critical systems?

12. Affected equipment?

13. Critical equipment?

14. Failure mode?

15. Result in a plant transient?

16. Result of a plant transient?

17. Result of a fire in the associated fire area?

18. Result of an internal fire elsewhere?

19. Result of a fire external to the plant?

20. Summary of Incident: **A pressure controller leaked oil and caused a fire at the primary pump. The fire was manually extinguished.**

Form #	Docket	Year	LER #
1-40	31-101		

Actuation of Fire Suppression Systems Checklist

1. Plant: **Caorso 1 (Italy)** Type: **BWR**
2. Date of Incident: **3/27/79**
3. % Power/Mode? **0%**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: X Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Valves, detective joint**
9. Affected area(s) of plant? **Unknown**
10. Affected plant system(s)? **CO_2 system**
11. Critical systems? **No**
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **CO_2 leakage caused CO_2 inoperability, evacuations**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **During CO_2 system maintenance, CO_2 leaked through 3 parts of the distribution manifold, rendering the system inoperable and requiring evacuation of areas affected by the leak. No damage was reported.**

Form #	Docket	Year	LER #
2-1			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Gravelineo 1 (France)** Type: **PWR**

2. Date of Incident: **4/16/88**

3. % Power/Mode? **Unknown**

4. Initiator? **Fire**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Auto deluge**

9. Affected area(s) of plant? **Transformer area**

10. Affected plant system(s)? **Transmission**

11. Critical systems?

12. Affected equipment? **Main transformer, stepdown transformer**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The main transformer exploded and caught fire, affecting the stepdown transformer and leading to loss of the 400 kV electric supply. The fire was initially sprayed by the automatic deluge system, then extinguished by firemen with foam.**

Form #	Docket	Year	LER #
2-2			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Flamanville 2 (France)** Type: **PWR**

2. Date of Incident: **6/6/89**

3. % Power/Mode? **Unknown**

4. Initiator? **Fire**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Advertent**

8. Components of fire suppression system which failed/initiated actuation? **Auto actuation**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **Resins Solidification**

11. Critical systems?

12. Affected equipment? **Mobile Unit**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **Yes**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A fire on the mobile unit of the TES resins solidification was extinguished by auto actuation of the area CO_2 system. There were no consequences to safety.**

Form #	Docket	Year	LER #
2-3			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Paluel 1 (France)** Type: **PWR**

2. Date of Incident: **5/23/84**

3. % Power/Mode? **Unknown**

4. Initiator? **Unknown-spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: _X_ **foam**

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Diesel Generator area**

10. Affected plant system(s)? **Diesel Generator system (LHP)**

11. Critical systems? **Yes**

12. Affected equipment? **Fuel Oil Tanks**

13. Critical equipment? **Yes**

14. Failure mode? **Foam in fuel oil**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **This event involved the spurious release of foam suppression agent into the LHP diesel generator fuel oil tanks.**

Form #	Docket	Year	LER #
2-4			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Flamanville 1 (France)** Type: **PWR**

2. Date of Incident: **2/28/86**

3. % Power/Mode? **Unknown**

4. Initiator? **Unknown - spurious**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: _X_ **foam**

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Diesel Generator area**

10. Affected plant system(s)? **LHQ Diesel Generators**

11. Critical systems? **Yes**

12. Affected equipment? **Fuel oil storage room, oil feedpumps**

13. Critical equipment? **Yes**

14. Failure mode? **Unspecified damage to oil feedpumps**

15. Result in a plant transient? No

16. Result of a plant transient? No

17. Result of a fire in the associated fire area? No

18. Result of an internal fire elsewhere? No

19. Result of a fire external to the plant? No

20. Summary of Incident: **Due to spurious release of the fire protection systems in the fuel oil storage room of the LHQ diesel generator, foam flooded the room and caused damage to the oil feedpumps.**

Form #	Docket	Year	LER #
2-5			

Actuation of Fire Suppression Systems Checklist

1. Plant: **St. Alban (France)** Type: **PWR**

2. Date of Incident: **10/13/87**

3. % Power/Mode? **Unknown**

4. Initiator? **Unknown - Spurious**

5. How many fire suppression systems actuated? **Unspecified number**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: _X_ **foam**

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Fuel oil tank rooms**

10. Affected plant system(s)? **LHQ Diesel Generators**

11. Critical systems? **Yes**

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **This event involved the spurious release of the fire protection systems in the rooms of the LHQ diesel generator fuel oil tanks.**

Form #	Docket	Year	LER #
2-6			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Nogent 1 (France)** Type: **PWR**

2. Date of Incident: **10/20/87**

3. % Power/Mode? **Unknown**

4. Initiator? **Testing activities**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: _X_ **foam**

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Unknown**

9. Affected area(s) of plant? **Fuel oil tank room**

10. Affected plant system(s)? **Diesel Generators**

11. Critical systems? **Yes**

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During performance of a fire detection test, the automatic foam fire protection system of the fuel oil tank room was actuated.**

Form #	Docket	Year	LER #
2-7			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Belleville 2 (France)** Type: **PWR**

2. Date of Incident: **4/6/88**

3. % Power/Mode? **Unknown**

4. Initiator? **Damaged valve component**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: _X_ **foam**

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Fuel oil tank rooms**

10. Affected plant system(s)? **Diesel Generators**

11. Critical systems? **Yes**

12. Affected equipment? **None specified**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **For unspecified reasons, the counterweight for the FPS actuating valve was damaged, resulting in the spurious release of fire protection foam in the rooms of the LHP diesel generator fuel oil tanks.**

Form #	Docket	Year	LER #
2-8			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cruas 1 (France)** Type: **PWR**
2. Date of Incident: **5/8/88**
3. % Power/Mode? **Unknown**
4. Initiator? **Unknown**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Diesel fuel oil tanks**
10. Affected plant system(s)? **Diesel generator**
11. Critical systems? **Yes**
12. Affected equipment? **Fuel oil tanks**
13. Critical equipment? **Yes**
14. Failure mode? **Tank flooded with water**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **The water fire protection system for the LHP diesel generator fuel oil tanks actuated (a valve was left open), flooding the tank and activating a fire alarm.**

Form #	Docket	Year	LER #
2-9			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Cattenom 2 (France)** Type: **PWR**
2. Date of Incident: **7/6/87**
3. % Power/Mode? **Unknown**
4. Initiator? **Sprinkler failure**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Sprinkler head**
9. Affected area(s) of plant? **Cable deck**
10. Affected plant system(s)? **None specified**
11. Critical systems?
12. Affected equipment? **LNF Switchboard**
13. Critical equipment? **Yes**
14. Failure mode? **Water in switchboard**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **When a sprinkler failed in the Cable Deck train "A," water flowed through unsealed openings on the LNF switchboard, which caused the board to be no longer isolated. No direct consequences to safety (the LNF switchboard supplies the radiation protection channels).**

Form #	Docket	Year	LER #
2-10			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Belleville 1 (France)** Type: **PWR**
2. Date of Incident: **7/6/87**
3. % Power/Mode? **Unknown - Startup**
4. Initiator? **Personnel Error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Unknown**
10. Affected plant system(s)? **ASG**
11. Critical systems? **Yes**
12. Affected equipment? **Motor driven pumps**
13. Critical equipment? **Yes**
14. Failure mode? **Wetting of pump motors - unavailable**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **During startup tests, a cleaning team employee mistook the fire protection controls for lighting and actuated the sprinkler system over two ASG motor-driven pumps.**

Form #	Docket	Year	LER #
2-11			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Paleul 2 (France)** Type: **PWR**
2. Date of Incident: **3/26/87**
3. % Power/Mode? **Unknown**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Valves**
9. Affected area(s) of plant? **Unknown**
10. Affected plant system(s)? **ASG**
11. Critical systems? **Yes**
12. Affected equipment? **Motor-driven pumps**
13. Critical equipment? **Yes**
14. Failure mode? **Wetting of pump motors - unavailable**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **In preparation for repair work, some valves for the nuclear island fire protection system were left open. The water distribution system was pressurized, leading to sprinkling of two ASG motor-driven pumps.**

Form #	Docket	Year	LER #
2-12			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Nogent 1 (France)** Type: **PWR**

2. Date of Incident: **7/8/87**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Pushbutton**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **ASG**

11. Critical systems? **Yes**

12. Affected equipment? **Turbine-driven pump**

13. Critical equipment? **Yes**

14. Failure mode? **Wetting of turbine driven pump - unavailable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The pushbutton for the sprinkler system over the ASG turbine driven pump was inadvertently actuated, wetting the pump and rendering it inoperable.**

Form #	Docket	Year	LER #
2-13			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Nogent 1 (France)** Type: **PWR**

2. Date of Incident: **8/28/87**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Pushbutton**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **ASG**

11. Critical systems? **Yes**

12. Affected equipment? **Motor-driven pump**

13. Critical equipment? **Yes**

14. Failure mode? **Wetting of pump - unavailable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **An accidental pushbutton actuation caused sprinkler water to wet the ASG motor-driven pump, rendering it unavailable for service.**

Form #	Docket	Year	LER #
2-14			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Paluel 4 (France)** Type: **PWR**
2. Date of Incident: **10/1/87**
3. % Power/Mode? **Unknown**
4. Initiator? **Unknown - spurious**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Unknown**
9. Affected area(s) of plant? **Unknown**
10. Affected plant system(s)? **RCV**
11. Critical systems? **Yes**
12. Affected equipment? **Charging pumps**
13. Critical equipment? **Yes**
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **The spurious release of the fire protection system lead to sprinkling of the RCV charging pumps.**

Form #	Docket	Year	LER #
2-15			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Gravelines 2 (France)** Type: **PWR**

2. Date of Incident: **9/28/88**

3. % Power/Mode? **Unknown**

4. Initiator? **JPI valve open - personnel error**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Valve**

9. Affected area(s) of plant? **Unknown**

10. Affected plant system(s)? **ISHP**

11. Critical systems? **Yes**

12. Affected equipment? **Pump motor**

13. Critical equipment? **Yes**

14. Failure mode? **Motor wetted - unavailable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **A JPI valve associated with fire hose reels had been left open since the last unit shutdown. During an inspection of those hose reels, water inadvertently sprinkled an ISHP pump motor, rendering it inoperable and unavailable for 24 hours for drying and inspections.**

Appendix B.2

FPS Actuation Data

Canadian Reactors

Form #	Docket	Year	LER #
3-1			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point Lepreau 1 (Canada)** Type: **Candu 6**

2. Date of Incident: **Unknown**

3. % Power/Mode? **Unknown**

4. Initiator? **Welding**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Cable Spreading Room**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Workmen welding in the cable spreading room neglected to isolate the ionization detection system. The 3000 gpm fire protection system actuated for about 5 minutes. No damage, but due to concern about water dripping through cracks to the MCC room below, splash covers were installed.**

Form #	Docket	Year	LER #
3-2			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point Lepreau 1 (Canada)** Type: **Candu 6**
2. Date of Incident: **Unknown**
3. % Power/Mode? **Unknown**
4. Initiator? **Smoke, Personnel error**
5. How many fire suppression systems actuated? **Two**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Detectors**
9. Affected area(s) of plant? **Diesel Generator Rooms**
10. Affected plant system(s)? **Diesel Generators**
11. Critical systems? **Yes**
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **A puff of smoke from a running diesel generator actuated the area smoke detectors and the deluge system. No equipment was damaged as spray hoods are installed. In an attempt to reset the deluge valve, the operator went to the wrong valve and actuated the deluge system for the other diesel generator. No damage was reported.**

Form #	Docket	Year	LER #
3-3			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point LePreau 1 (Canada)** Type: **Candu 6**

2. Date of Incident: **Unknown**

3. % Power/Mode? **Unknown**

4. Initiator? **Condensation**

5. How many fire suppression systems actuated? **Two**

6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: ___ Other: _X_ foam

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Heat Detector**

9. Affected area(s) of plant? **No. 2 Fuel Oil Tanks**

10. Affected plant system(s)? **Diesel Generators**

11. Critical systems? **Yes**

12. Affected equipment? **Fuel Oil Tanks - Oil**

13. Critical equipment? **Yes**

14. Failure mode? **Oil contamination renders diesel unavailable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The heat detector inside the fuel oil tank spuriously actuated the foam system twice. The only reason appeared to be due to condensation in the detector mounting box. The actuation caused oil contamination rendering the diesel unavailable.**

Form #	Docket	Year	LER #
3-4			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point LePreau 1 (Canada)** Type: **Candu 6**

2. Date of Incident: **Unknown**

3. % Power/Mode? **Unknown**

4. Initiator? **Unknown**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Cable riser area**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **The deluge system in the cable riser area was actuated by the ionization detectors (no cause was specified). There was no damage as adjacent MCC's had spray shields.**

Form #	Docket	Year	LER #
3-5			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point LePreau 1 (Canada)** Type: **Candu 6**
2. Date of Incident: **Unknown**
3. % Power/Mode? **Unknown**
4. Initiator? **Personnel error**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water ___ CO_2: ___ Halon: _X_ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Detectors**
9. Affected area(s) of plant? **Telecom Room**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Maintenance men working in the Telecom room inadvertently actuated the ionization detectors and the Halon system. No damage resulted.**

Form #	Docket	Year	LER #
3-6			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Point LePreau 1 (Canada)** Type: **Candu 6**

2. Date of Incident: **Unknown**

3. % Power/Mode? **Unknown**

4. Initiator? **Malfunctioning detectors**

5. How many fire suppression systems actuated? **Three**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Turbine auxiliaries**

11. Critical systems? **Yes**

12. Affected equipment? **Vacuum pumps**

13. Critical equipment? **Yes**

14. Failure mode? **Flooding of vacuum pumps makes them inoperable**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **On the separate occasions, heat detection system malfunctions actuated the deluge system (one of three) below the turbine high pressure end. In one instance, the vacuum pumps were flooded, ceased to operate, and almost caused a unit shutdown. The system was converted to preaction.**

Form #	Docket	Year	LER #
3-7			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Gentilly-2 (Canada)** Type: **Candu 6**

2. Date of Incident: **9/22/83**

3. % Power/Mode? **100%**

4. Initiator? **Welding**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Detectors**

9. Affected area(s) of plant? **Turbine Building**

10. Affected plant system(s)? **Turbine/generator**

11. Critical systems? **Yes**

12. Affected equipment? **Lube oil reservoir**

13. Critical equipment? **Yes**

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **Welding activity tripped infrared detectors and spuriously actuated the deluge system over the lube oil reservoir. No damage was reported.**

Form #	Docket	Year	LER #
3-9			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Pickering A (Canada)** Type: **Candu**
2. Date of Incident: **12/31/80**
3. % Power/Mode? **96% (Units 1,4), 100% (Units 2,3)**
4. Initiator? **Rupture**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Piping**
9. Affected area(s) of plant? **Yard-outside**
10. Affected plant system(s)? **Fire protection**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **Degraded FPS operability**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **The main yard fire protection header failed near the Unit 1 main transformer foundation. An immediate drop in high pressure service water system pressure occurred, requiring isolation from the fire header. Due to the number of valves required to fully isolate the leak, fire protection systems for a number of areas were inoperable, requiring fire patrols.**

Form #	Docket	Year	LER #
3-10			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Bruce A (Canada)** Type: **Candu**
2. Date of Incident: **2/25/82, 2/27/82**
3. % Power/Mode? **88%**
4. Initiator? **Controller calibration**
5. How many fire suppression systems actuated? **Two**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Deluge control unit**
9. Affected area(s) of plant? **Main Transformer area**
10. Affected plant system(s)? **Transmission/Distribution**
11. Critical systems? **Yes**
12. Affected equipment? **Main Transformer**
13. Critical equipment? **Yes**
14. Failure mode? **Deluge prompted unit trip**
15. Result in a plant transient? **Yes**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **The deluge system over the Main Transformer spuriously tripped on two occasions, apparently due to incorrect temperature compensation in the deluge control unit (both incidents occurred on sunny days). The transformers were taken off potential and the turbine generator was unloaded upon the actuations.**

Form #	Docket	Year	LER #
3-11			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Bruce A (Canada)** Type: **Candu**

2. Date of Incident: **9/12/82**

3. % Power/Mode? **Unknown**

4. Initiator? **Structural Defect - piping**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Piping**

9. Affected area(s) of plant? **Yard - outside**

10. Affected plant system(s)? **None**

11. Critical systems?

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While stroking fire water supply valves to the ECI system, an underground header which supplies firewater to the accumulator building ruptured. The most probable cause was a structural defect in the piping. Backup fire protection was provided to the affected areas during repairs.**

Form #	Docket	Year	LER #
3-12			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Bruce A (Canada)** Type: **Candu**
2. Date of Incident: **9/26/82**
3. % Power/Mode? **"High power"**
4. Initiator? **Possible sabotage, personnel action**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Break Glass Station**
9. Affected area(s) of plant? **Oil storage tank area**
10. Affected plant system(s)? **Standby generator**
11. Critical systems? **Yes**
12. Affected equipment? **Oil tank**
13. Critical equipment? **Yes**
14. Failure mode? **Flooding contaminated diesel oil**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **Possible tampering with, or accidental actuation of, a break glass station for the standby generator oil tank FPS caused actuation and flooding of the oil tank with over 2500 gallons of water. Measures were taken to isolate the contaminated oil from the SG's until the water could be skimmed.**

Form #	Docket	Year	LER #
3-13			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Bruce B (Canada)** Type: **Candu**

2. Date of Incident: **5/16/83**

3. % Power/Mode? **Unknown**

4. Initiator? **Personnel error, procedural deficiency**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Break glass station**

9. Affected area(s) of plant? **Standby generator room**

10. Affected plant system(s)? **Standby Diesels**

11. Critical systems? **Yes**

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **None**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **While setting up for a test in the Standby Generator Room No. 6, an operator incorrectly gained access to the break glass button (even though the blocking handswitch was in "Isolate" position), actuating the room CO_2 system. No equipment damage or personnel injuries occurred.**

Form #	Docket	Year	LER #
3-14			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Pickering B (Canada)** Type: **Candu**
2. Date of Incident: **6/11/85**
3. % Power/Mode? **Unknown**
4. Initiator? **Water hammer during flushing**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Piping**
9. Affected area(s) of plant? **Yard area**
10. Affected plant system(s)? **FPS systems**
11. Critical systems? **No**
12. Affected equipment? **Fire hydrants**
13. Critical equipment? **No**
14. Failure mode? **Degraded FPS operability**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **During an inspection of a potentially defective fire hydrant, one hydrant was opened for flushing and caused a system water hammer. The underground piping near the hydrant ruptured, flooding the immediate yard area and rendering a number of hydrants inoperable.**

Form #	Docket	Year	LER #
3-15			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Pickering A (Canada)** Type: **Candu**
2. Date of Incident: **9/4/86**
3. % Power/Mode? **25%**
4. Initiator? **Defective (aged) hose**
5. How many fire suppression systems actuated? **One**
6. Suppression system(s) involved?

   Water _X_ CO_2: ___ Halon: ___ Other: ___
7. Advertent or Inadvertent Actuation? **Inadvertent**
8. Components of fire suppression system which failed/initiated actuation? **Hose**
9. Affected area(s) of plant? **Unknown**
10. Affected plant system(s)? **None**
11. Critical systems?
12. Affected equipment? **None**
13. Critical equipment?
14. Failure mode? **None**
15. Result in a plant transient? **No**
16. Result of a plant transient? **No**
17. Result of a fire in the associated fire area? **No**
18. Result of an internal fire elsewhere? **No**
19. Result of a fire external to the plant? **No**
20. Summary of Incident: **While backwashing of condensate extraction pump strainers was in progress, the fire hose used for backwashing split and whipped past operators who narrowly escaped injury. No equipment damage occurred.**

Form #	Docket	Year	LER #
3-16			

Actuation of Fire Suppression Systems Checklist

1. Plant: **Bruce A (Canada)** Type: **Candu**

2. Date of Incident: **6/12/87**

3. % Power/Mode? **0% (annual outage)**

4. Initiator? **Defective discharge head**

5. How many fire suppression systems actuated? **One**

6. Suppression system(s) involved?

   Water ___ CO_2: _X_ Halon: ___ Other: ___

7. Advertent or Inadvertent Actuation? **Inadvertent**

8. Components of fire suppression system which failed/initiated actuation? **Discharge head**

9. Affected area(s) of plant? **Standby Diesel Room No. 3**

10. Affected plant system(s)? **Standby Diesel No. 3**

11. Critical systems? **Yes**

12. Affected equipment? **None**

13. Critical equipment?

14. Failure mode? **SG test was terminated due to CO_2 actuation**

15. Result in a plant transient? **No**

16. Result of a plant transient? **No**

17. Result of a fire in the associated fire area? **No**

18. Result of an internal fire elsewhere? **No**

19. Result of a fire external to the plant? **No**

20. Summary of Incident: **During a 12-hour load and rejection test of the No. 3 Standby Generator, the room CO_2 system actuated while under investigation by an operator. The blocking switch was in the "Isolate" position. The cause was a defective discharge head. The SG3 test was terminated; no equipment damage occurred.**

Appendix B.3

FPS Actuation Data

Miscellaneous Foreign Event
Title Abstracts

Item #	Type	Date	Abstract
3	BWR	7/27/84	Fire protection spray valve opened in the turbine building, causing flood level signal A-isolation and a plant scram.
4	PWR	9/27/88	A fire extinguishing line leaked due to lack of weld bead and inadequate pipe support.
6	PWR	10/28/88	A fire extinguisher system leak caused faults in emergency feedwater valve actuators.
19	BWR	10/12/87	Normal wear caused leakage of a fire protection valve stuffing box.
20	BWR	7/1/87	Leakage of fire hydrants occurred due to debris on the diaphragms, and freezing weather.
36	PWR	7/6/87	Failure of a fire protection system sprinkler caused an isolation fault in uninterruptible power.
37	PWR	9/23/87	Corrosion caused large leaks in the Auxiliary Building fire protection system.
38	PWR	10/24/87	A leak occurred in the packing box of a primary coolant system pump sprinkler valve.
39	BWR	2/9/87	A spurious fire alarm activated electrical service tunnel sprinklers and caused a scram.
40	PWR	6/28/87	A plug came loose from a fire protection system flange and sprayed the diesel fire pump.
42	BWR	4/7/87	During testing, a fire protection system sprinkler sight glass burst due to improper installation.
43	BWR	2/19/87	A fire system monitoring system switch tripped, resulting in low carbon dioxide tank level.
44	BWR	1/24/87	Rubbing of underground fire system and tap water lines caused both to leak.
47	BWR	5/14/87	A fire protection system leak was caused by a defective flange gasket.
50	PWR	7/26/87	Personnel actuated a fire protection sprinkler which sprayed auxiliary feedwater pumps.

Item #	Type	Date	Abstract
59	PWR	10/17/86	Human error caused inadvertent operation of various fire protection system equipment.
60	BWR	8/8/86	A water drip leak in the fire protection pump shaft seal leaked into the bearing lube oil.
61	BWR	7/5/86	The mechanical seal on the diesel-driven fire water pump was replaced due to leakage.
73	PWR	1/5/87	A fire protection system buried line broke and water filled the inlet structure stuffing box chamber room.
75	BWR	6/21/88	During maintenance, a fire sprinkler was damaged and sprayed water on a condensate pump, so unit load was reduced.
77	PWR	3/27/87	An error in testing the fire protection system resulted in two auxiliary feedwater pumps being sprayed with water.
85	BWR	2/9/87	A spurious actuation of the fire protection system caused an electrical conduit room high level signal and a scram.
96	BWR	10/28/85	While searching for an electronic fault, a fire protection valve was actuated, causing a turbine trip and reactor scram.
105	BWR	1/30/86	A leak was discovered in the main fire protection line to the turbine and reactor buildings.
110	BWR	5/13/85	While testing a fire protection pump, personnel noticed water leaking from the pump's shaft seal.
117	BWR	10/20/85	The fire sprinkler system was inoperable due to repair of leakage.
118	BWR	10/19/85	Eighteen fire detectors malfunctioned due to spurious sprinkling.
124	BWR	7/23/85	The fire extinguisher system foam tank was inadvertently overfilled.
135	BWR	6/28/85	Personnel discovered a leak from a seal in a fire protection system valve.

Item #	Type	Date	Abstract
143	BWR	6/28/85	A valve in the fire protection system leaked from an improperly installed o-ring (similar or identical to item #135).
146	PWR	1/20/85	Fire protection system leak causes loss of auxiliary power supply and results in a scram.
151	BWR	8/10/84	A spurious signal opened a fire sprinkler system's sprinkler valve and caused a reactor trip.
153	BWR	9/26/84	A fire protection system pump developed a seal leak.
154	BWR	10/28/84	A leak was observed from a fire hydrant.
157	BWR	10/25/84	The Halon gas extinguishers for the diesel generator room were accidently tripped.
165	PWR	5/14/84	Fire protection systems were inadvertently actuated during battery tests.
168	BWR	1/18/84	Large leaks were found in a section of the fire protection system piping.
173	PWR	11/3/83	A diesel fire pump developed a seal leak.
176	BWR	8/22/83	During excavation and earth
180	BWR	8/22/83	During excavation and earth moving work, a water supply line to two fire hydrants was broken.
181	PWR	5/30/83	A test of the fire alarm system for the diesel rooms actuated the Halon system.
182	PWR	3/7/83	Removal of a rectifier from service caused actuation of the Halon fire protection system for two diesels.
183	BWR	2/11/83	A reactor building fire hydrant valve froze and burst.
191	PWR	4/18/81	A reactor coolant aspersion (sprinkler) valve leaked due to faulty installation.
198	BWR	11/4/82	A service water system pipe that services five fire hose outlets leaked due to corrosion.

Item #	Type	Date	Abstract
199	BWR	7/3/82	A fire protection system pipe leaked when a hole developed due to corrosion in the carbon steel piping.
205	BWR	12/19/79	Fire protection spray line fails due to improper threading.

APPENDIX C

FIRE PROTECTION SYSTEM SEISMIC PERFORMANCE DATA

CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION

This report documents an investigation into the performance and effects of fire protection systems resulting from the October 17, 1989 Loma Prieta earthquake. The Loma Prieta earthquake affected a large extent of the San Francisco Bay area and provided an unprecedented opportunity to assess the performance of modern fire protection systems.

This study has focused on the collection of a large sample of fire protection systems subject to a wide range of ground motions. Of interest was the success and failure data for designs incorporating wet and dry water systems, Halon and CO_2 suppressants. Data on system performance was collected from about two dozen sources. These include federal and state facilities as well as private corporations.

No activations or failures of Halon or CO_2 fire protection systems were reported for the approximately 100 systems investigated. Of the approximately 1000 water sprinkler systems investigated, 13 failures were reported.

Correlation of system performance with engineering damage measures was performed. Of the engineering measures investigated, peak ground acceleration was found to correlate best with the observed damage data for water sprinkler systems. A median fragility was developed for water sprinkler systems designed in accordance with NFPA-13 standards to fit the observed data along with correction factors to allow application to nuclear structures.

2.0 LOMA PRIETA EARTHQUAKE DESCRIPTION

The Loma Prieta earthquake of October 17, 1989 produced strong ground shaking over an area of more than 5000 square kilometers. The heavily shaken region included large portions of both the Monterey and San Francisco Bay areas. Urban areas in this region include a population of over 3 million people. Loma Prieta was the most damaging earthquake in California since the great San Francisco earthquake of 1906.

The Loma Prieta earthquake created sporadic damage that extended into 10 California counties. Damage was reported as far north as Benicia on the Sacramento River, and as far south as Salinas and Monterey. However, these effects far distant from the earthquake source were anomalies. The most severe damage was concentrated in Santa Cruz, Southern San Mateo, and western Santa Clara counties.

Earthquake effects averaged over an area can be characterized by standard ratings of damage intensity. The United States Geological Survey (USGS) prepared a preliminary map of Modified Mercalli intensities (MMIs) shortly after the earthquake (Ref. 2.1). A standard description of Modified Mercalli intensity is presented in Appendix A of Reference 2.1. The USGS intensity map is reproduced in Figure 2.1. The map includes samples of recorded peak ground acceleration (PGA). These PGAs measured in the October 17 main shock were primarily from the extensive arrays of permanent strong-motion instruments maintained by the California Division of Mines and Geology (CDMG), and the USGS (Refs. 2.2 and 2.3).

The most heavily damaged region of MMI VIII covers about 900 square kilometers, surrounding the epicenter and rupture trace of the fault. This near-source region covers most of southern Santa Cruz County, including the towns of Santa Cruz (pop. 50,000), Watsonville (pop. 30,000), Capitola (pop. 10,000), and Scotts Valley (pop. 9,000).

In the near-source region, over 100 businesses (most of them small) were lost or displaced due to serious structural damage, primarily in the central districts of Santa Cruz and Watsonville (Ref. 2.4). It was estimated that about 25 percent of central Watsonville and central Santa Cruz would have to be rebuilt. In addition, an estimated 200 homes and 70 commercial buildings were destroyed or damaged beyond repair, about 60 by fire (Ref. 2.4). The total direct loss to public and private property was estimated at over $300 million in Santa Cruz County.

The area designated as MMI VII covers the northern half of the Monterey Bay area, most of the Santa Clara Valley, the Santa Cruz Mountains, most of the San Francisco Peninsula, and extends slightly into Marin and across the bay into Oakland. This area of over 5,000 square kilometers includes all or major portions of four California counties. The MMI VII area is termed the "affected region," the region of sporadic damage. Intensity VII corresponds to minor damage to modern construction that is built to standards such as the **Uniform Building Code** (UBC), which for a Seismic Zone IV such as California, includes provisions for earthquake loads. Modern homes and commercial buildings in regions of

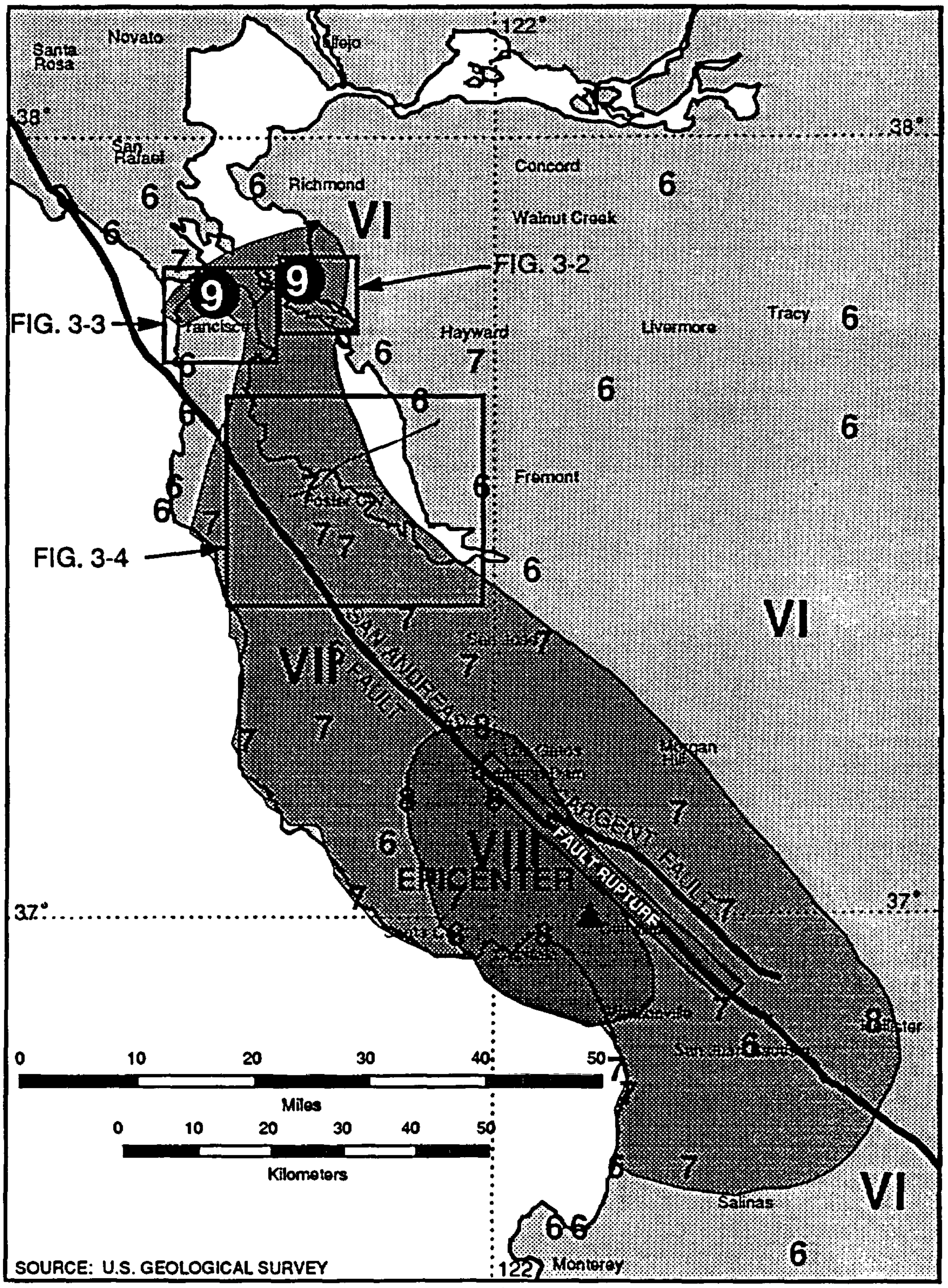

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Figure 2.1. USGS Intensity Map

MMI VII typically suffer internal effects such as spilled shelves, fallen suspended ceiling panels, and possibly cracked plaster and sheetrock, but no serious structural damage. Damage to older (pre-1930s) structures is sometimes more serious, especially to unreinforced masonry. The designation of MMI VII represents the average level of earthquake effects over a large area, and does not exclude the extremes of serious damage, even to modern structures, due to anomalous circumstances.

The most dramatic damage occurred near the perimeter of the affected region of MMI VII, in San Francisco and Oakland, over 60 kilometers from the epicenter. The concentration of a wide variety of structures within a major city presents a large exposure, or damage potential, for even moderate ground motion. The older, more vulnerable construction within the cities is located on soft landfill near the bay, creating a combination of bedrock amplification and soil settlement.

Nearly all modern steel-frame high-rise buildings (constructed since the 1960s) performed very well, with damage limited to interior contents. In nearly all cases, normal business operations were resumed when power was restored.

The single major fire in San Francisco destroyed an apartment building near the center of the soft-landfill Marina area. The fire was a limited reenactment of the 1906 disaster. Ruptured gas lines within the building started the fire. Fire fighters quickly lost water pressure from broken mains buried in the soft soil. An expanded conflagration was prevented by emergency pumping from the city's fireboat standing offshore in the bay and the lack of winds that evening.

Settlement of soft fill, as well as isolated sites of liquefaction, was a source of damage in west Oakland, and at certain locations along the west shoreline of the bay. Settlement in the Port of Oakland damaged piers, roadways, and rail lines. The end of the runway adjacent to the bay at Oakland Airport slumped, temporarily halting flights. The effect of settlement was obvious in the streets of downtown San Francisco near the waterfront, with dips, vertical offsets, and cracking in sidewalks that were originally level.

Perhaps the most universal and long-lasting effect of the earthquake was the interruption in highway traffic. The earthquake closed major traffic arteries on both sides of the bay. Of minor inconvenience was the closure of two short sections of urban freeway, Highways 480 and 280 wrapping around the bay shore of San Francisco, and several on-ramps from downtown San Francisco to Highways 80 and 101. Repairs were estimated to take a year. The collapse of a mile-long section of Highway 880 in west Oakland, the elevated Cypress Structure, was the worst disaster of the earthquake, accounting for half of the fatalities. Construction of an alternative section of freeway was expected to require years.

The disconnection of a short section of the upper deck of the Bay Bridge severed the traffic link between San Francisco and Oakland. The bridge normally carries an average of 170,000 vehicles making round-trip crossings each day. This traffic accounts for one-third of the work staff in San Francisco's financial district. Crews working around the clock were able to replace the damaged section and reopen the bridge in four weeks.

In all, the earthquake was estimated to cost the Monterey and San Francisco Bay areas over $6 billion in direct damage. This amounts to approximately $1000 for every person living in the greater San Francisco and Monterey Bay areas. Damage in the city of Oakland alone was estimated at $1.3 billion, not including the replacement cost of the Cypress Structure.

2.1 References

2.1 Plafker, George, and John P. Galloway, eds., Lessons Learned From the Loma Prieta, California Earthquake of October 17, 1989, U.S. Geological Survey Circular 1045, 1989.

2.2 California Division of Mines and Geology, CSMIP Strong-Motion Records From the Santa Cruz Mountains (Loma Prieta), California Earthquake of 17 October 1989, Report OSMS 89-06, 1989.

2.3 U.S. Geological Survey (USGS), U.S. Geological Survey Strong-motion Records from the Northern California (Loma Prieta) Earthquake of October 17, 1989, Open-File Report 89-568, 1989.

2.4 EQE Engineering, The October 17, 1989 Loma Prieta Earthquake Effects on Selected Power and Industrial Facilities, Draft Report, April 1990.

3.0 FIRE PROTECTION PERFORMANCE STUDY OVERVIEW

Data collection was initiated with telephone calls to over two dozen city building departments, fire officials, state offices, federal and local agencies, and private companies. These discussions produced data regarding availability and feasibility of data collection.

A primary objective of the preliminary survey was to select sites to visit. Selection of site visits was based on various factors including number and type of fire protection systems, age of construction and reported damage. Sites were also selected in order to achieve a range of ground motion intensities.

For sites not visited, telephone interviews with facility personnel and review of facility fire protection performance reports, where available, were conducted. Data collected includes number of protected structures, age of construction, and type of fire protection systems.

The predominant water suppression system design was found to be a wet closed head type. The mild climate in California does not require the use of dry pre-action type systems for general use. Dry pre-action systems are more expensive to install and are therefore limited to installations with special needs or which require higher reliability. Site visit data for Halon and CO_2 systems was limited since most visited sites had primarily water fire suppression systems. Most data regarding Halon and CO_2 performance was collected from telephone conversations.

3.1 Discussion of Sites

A general description of the sites investigated and the performance of the fire protection systems at those sites is presented. Sites were selected to be visited based on both quality of available data and ground motion intensity (to obtain a broad range of ground motion intensities). Figure 3.1 gives an overall intensity map of the Loma Prieta earthquake and the sites visited are identified in Figures 3.2 through 3.4. A brief overview of facility performance is provided below.

The Oakland Harbor

The Oakland harbor includes several large government facilities which were located in a region of strong ground motion. These include the Alameda Naval Air Station, the Oakland Army Base, the Oakland Naval Supply Center, and the Port of Oakland. These facilities are located on bay mud and fill and are close to the well-reported elevated freeway collapse, the I-880 Cypress structure (Figure 3.2). A strong ground motion recording taken at the Oakland Harbor Outer Wharf indicated a peak ground acceleration of 0.29 g. A response spectra for this record is shown in Figure 4.1. A description of the facilities and the performance of their fire protection systems is provided as obtained from site visits, interviews with facility engineering and fire officials, and post earthquake reports (Ref. 3.1).

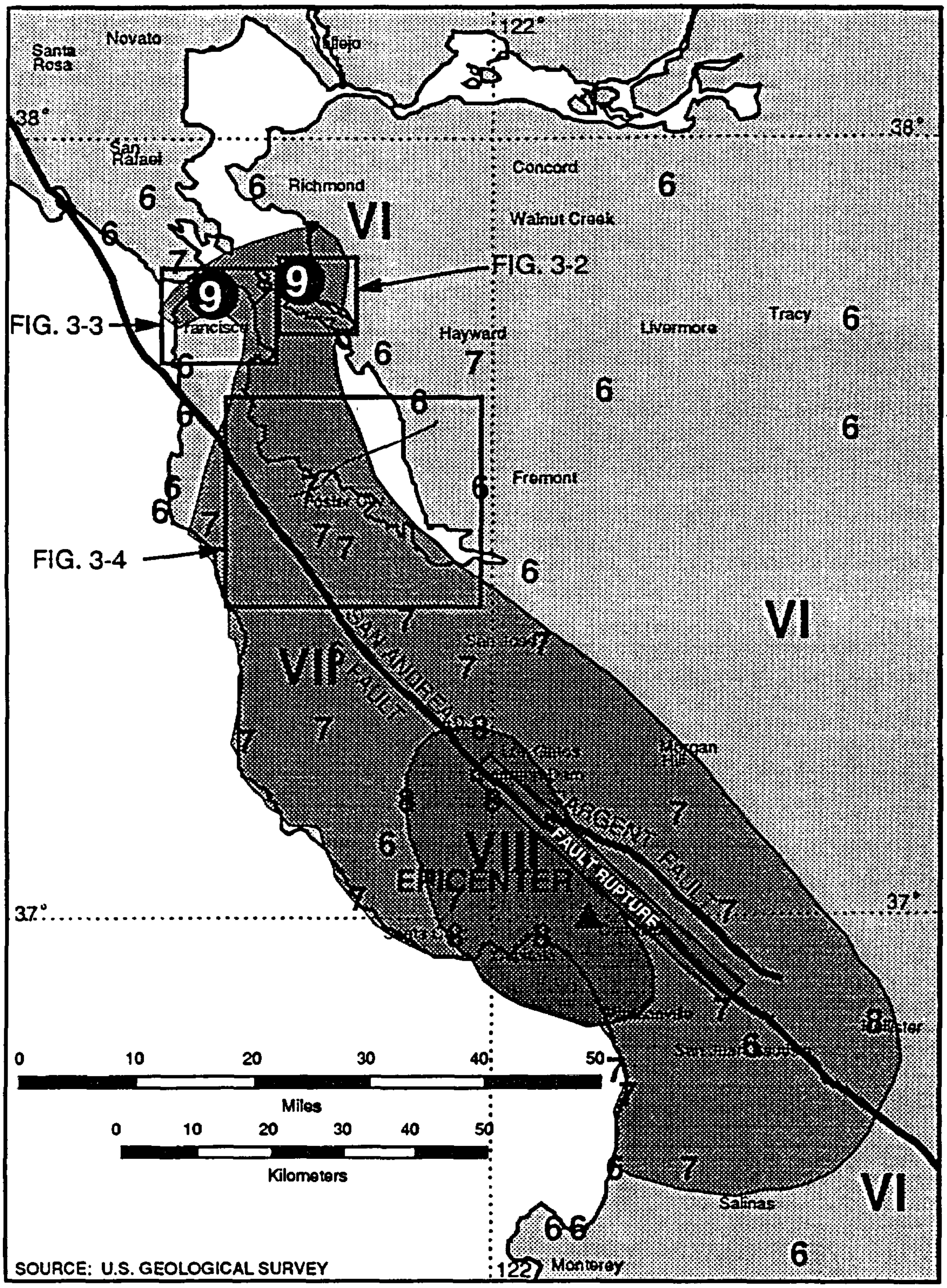

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Figure 3.1. Modified Mercalli Intensity Map. October 17, 1989 Loma Prieta Earthquake.

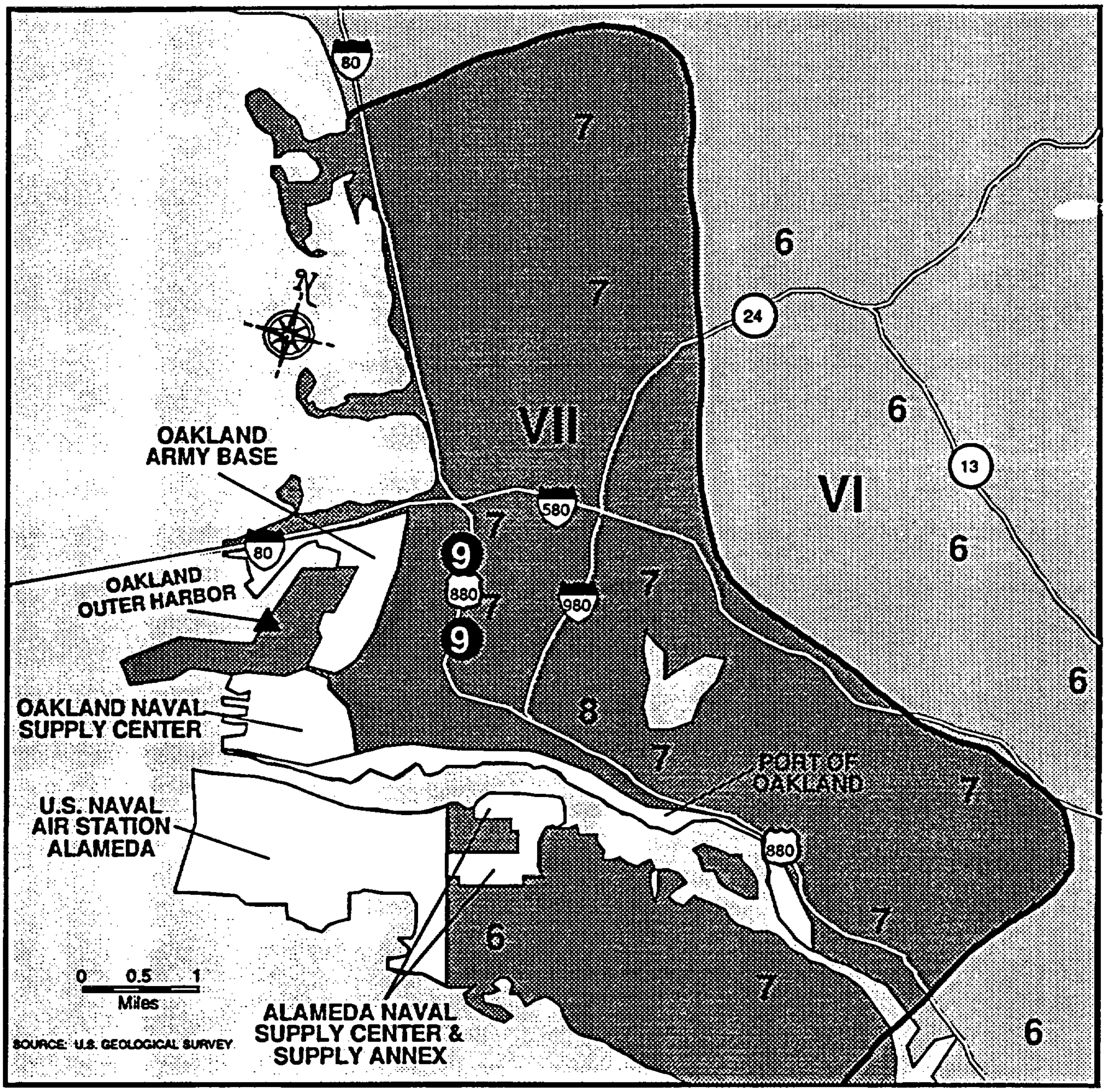

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Figure 3.2. October 17, 1989 Loma Prieta Earthquake. Modified Mercalli Intensity Map of Oakland and Alameda. Sites investigated and ground motion recording locations shown.

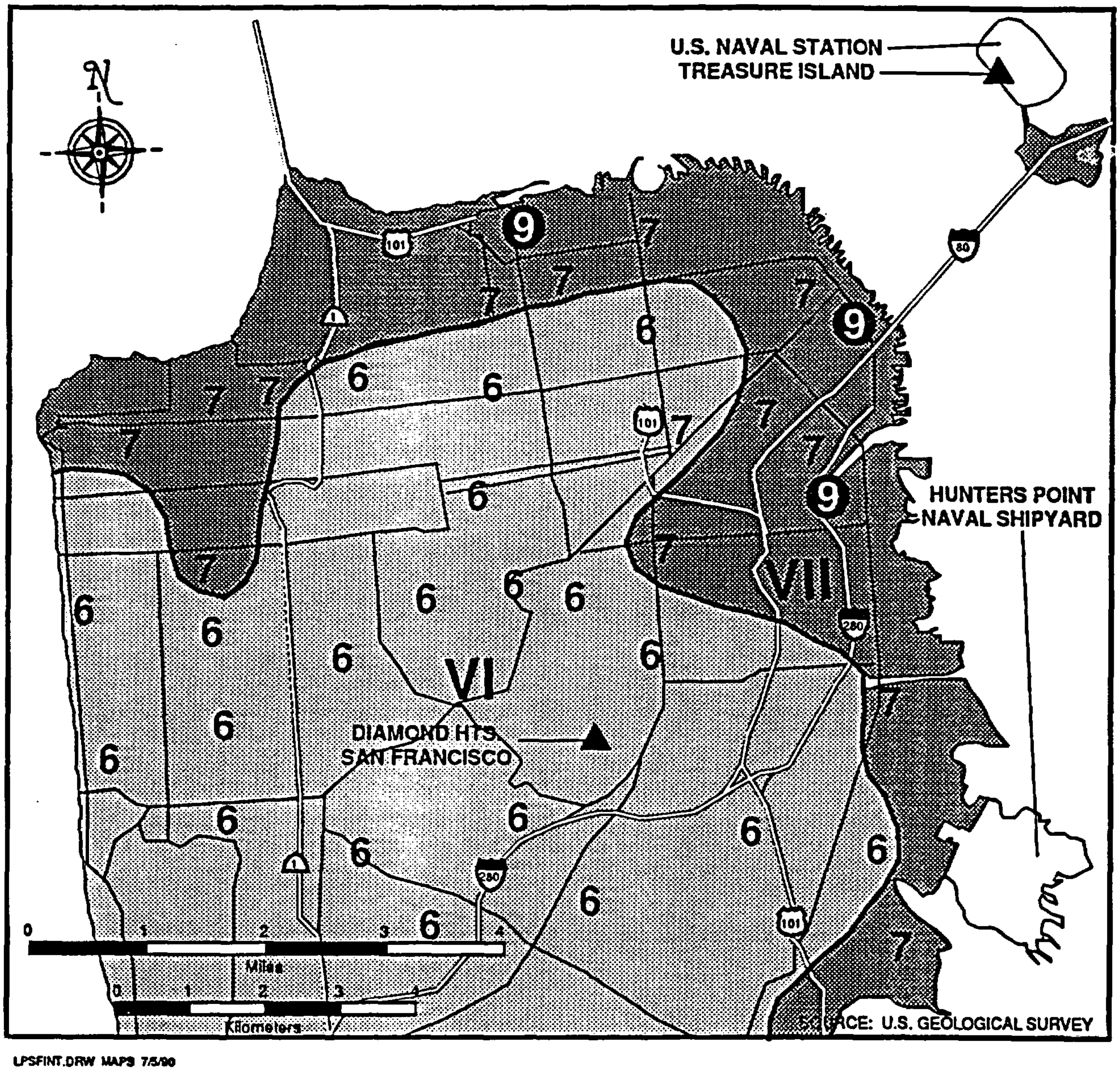

Figure 3.3. October 17, 1989 Loma Prieta Earthquake. Modified Mercalli Intensity Map of San Francisco. Sites investigated and ground motion recording locations shown.

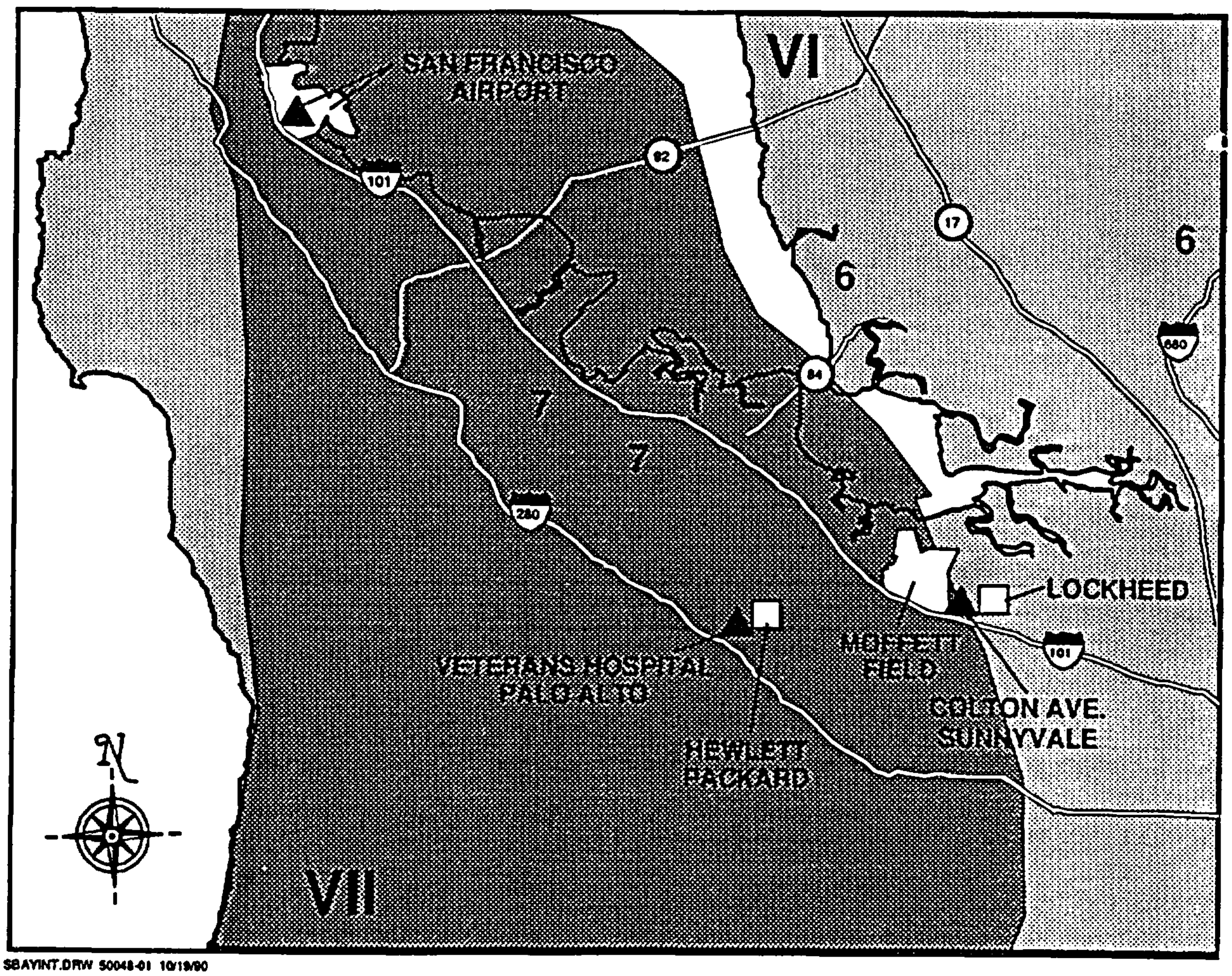

Figure 3.4. October 17, 1989 Loma Prieta Earthquake. Modified Mercalli Intensity Map of South Bay Area. Sites investigated and ground motion recording locations shown.

Alameda Naval Air Station

The Alameda Naval Air Station operates as the primary bay area naval port facility. The station occupies the northern end of Alameda island and is flanked by the bay to the west and the Oakland/Alameda inner harbor to the east. The air station has aircraft and helicopter repair hangers, painting facilities, warehouses, fuel storage, and personnel barracks.

The Alameda Naval Air Station has approximately 90 structures, most of which were built during original construction circa 1940. Original construction is wood frame and steel frame while newer construction includes steel-frame and reinforced concrete structures.

Overall, the base suffered minor damage as a result of the earthquake. One of three water towers suffered structural damage and is no longer used. Two runways were damaged and have since been restored.

Fire protection systems at the station cover an area of 2.3 million square feet. Most of the systems are wet with a limited number of deluge systems. Systems were installed during the original construction with the exception of the recently completed paint hanger.

Overall, the fire protection systems were installed in an orderly and regular fashion and were generally well supported. All risers had lateral braces (Figure 3.5). All systems were installed to prevailing NFPA standards.

The only significant problem was the inadvertent actuation of a deluge valve. The actuation was a result of low air pressure in the actuation line. The base experienced a power outage resulting in a loss of the air compressors which further caused a slow drop in the air actuation line pressure. Normally, a low pressure indicator in the firehouse would trip and the system would be deactivated. After the earthquake, however, the low pressure signal did not trigger and approximately 10 minutes after the earthquake the system actuated due to low air pressure. A representative valve station is shown in Figure 3.6.

The two other instances of damage to fire protection systems were a leak in a pipe running under a pier and a leaking standpipe.

Oakland Army Base

The Oakland Army base is located at the east end of the Bay Bridge. The base is used as a warehouse and storage facility supplying military units in the Pacific.

The Oakland Army base was constructed in 1941 and is built on landfill construction primarily wood frame (Figure 3.7). Most of the fire protection systems were installed during original construction. All of the systems on the Oakland Army base are wet systems.

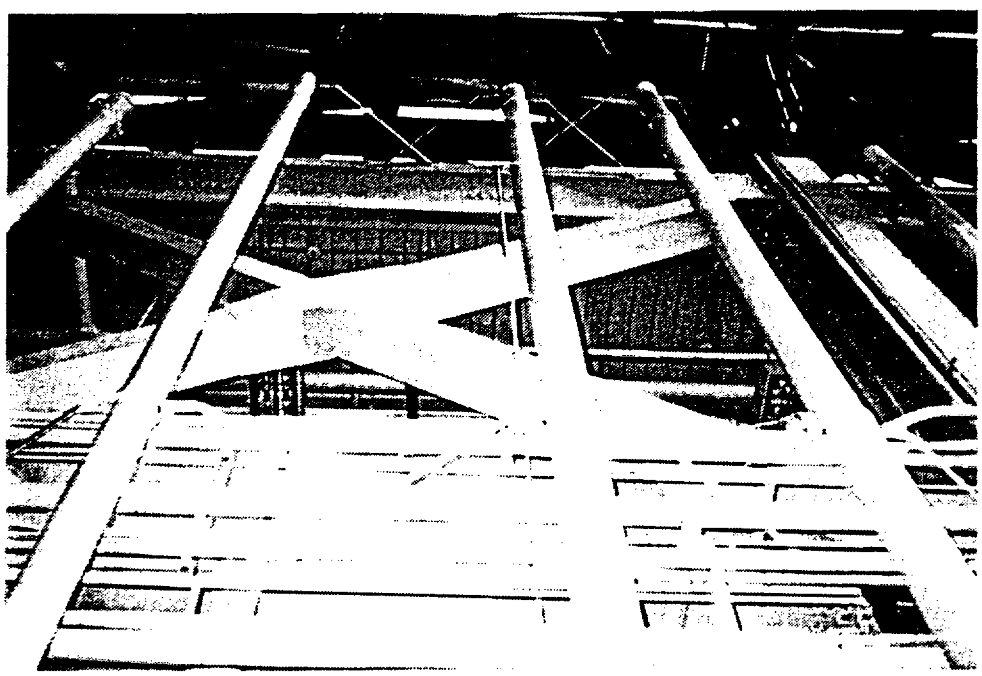

Figure 3.5. Lateral Restraints on Feed Line Risers at Alameda Naval Air Station

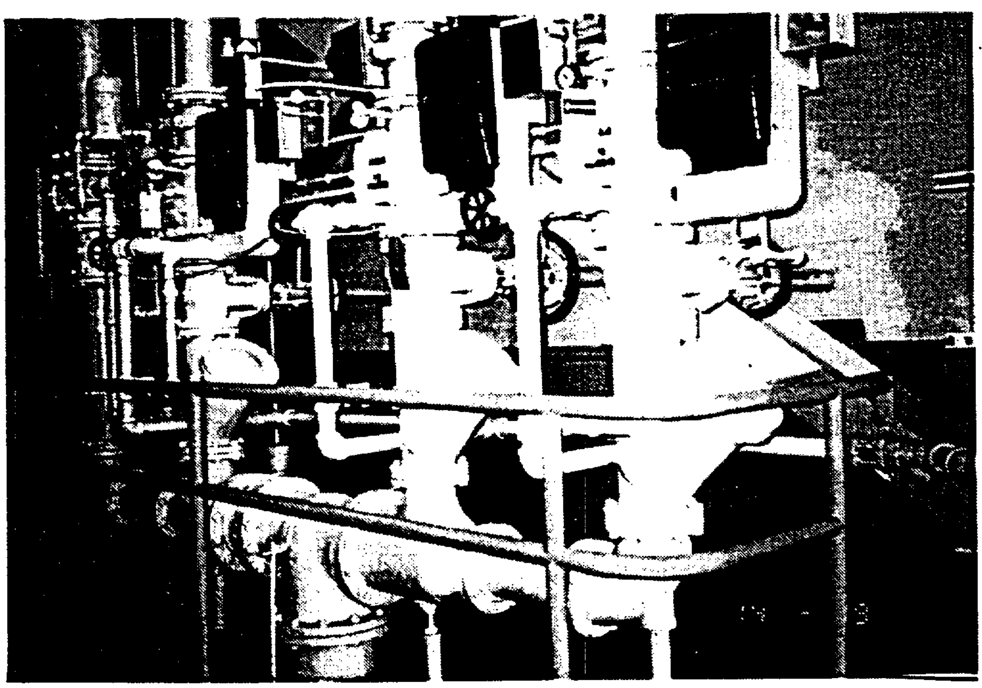

Figure 3.6. Deluge Valve Station at Alameda Naval Air Station

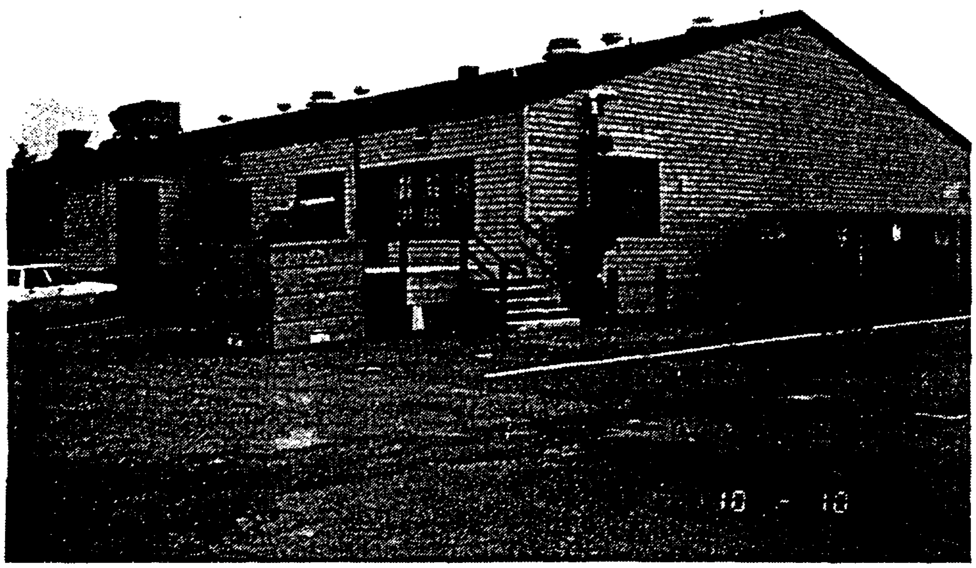

Figure 3.7. Typical Wood-Frame Structure at Oakland Army Base

While there were signs of minor building settlement, the settlement was not as widespread or severe as observed at other landfill sites.

The fire protection piping performed well in the earthquake. There was only one reported piping leak at a 6-inch diameter threaded elbow which reportedly sealed itself a short time after the earthquake. The fire protection functionality, however, was lost due to numerous underground water main leaks.

The fire protection systems were installed during original construction (circa 1940). Lateral bracing was supplied for all risers. At two locations, the braces had pulled out without any resulting damage to the pipe.

Oakland Naval Supply Center

Oakland Naval Supply Center is located just south of the east end of the Bay Bridge. The facility serves as a supply center for the various naval bases in the bay area.

The Oakland Naval Supply Center was constructed in 1941 and is built entirely on landfill. The older structures are primarily wood frame. Newer construction includes steel-frame and reinforced concrete structures.

The fire protection systems were installed during original construction, with the exception of water systems in newly constructed inaccessible sensitive areas and a Halon system in the computer area.

Overall, the base had numerous soil-related failures. Observations include road subsidence and swelling, and building settlement. Following the earthquake, it was reported that many of the water mains had underground leaks.

The Naval Supply Center has nine warehouses along the waterfront which experienced extensive fire protection system damage. The warehouses have two 8-inch feed lines per bay and three bays per warehouse. The warehouses have steel columns and trusses supporting wood rafters.

Soil liquefaction contributed to the fire protection system problems. It was reported that virtually all of the 8-inch feed lines broke at the floor penetration flange connection (Figure 3.8). The flange connection is about 6 inches from the floor. Reportedly, the pipe was forced up through the penetration causing shearing of the flange bolts. The resulting displacement caused the lower flange to be 6 inches above the interior feed line flange.

The forces produced by the pipe uplift also contributed to failures in threaded elbow joints at the top of the feed line risers.

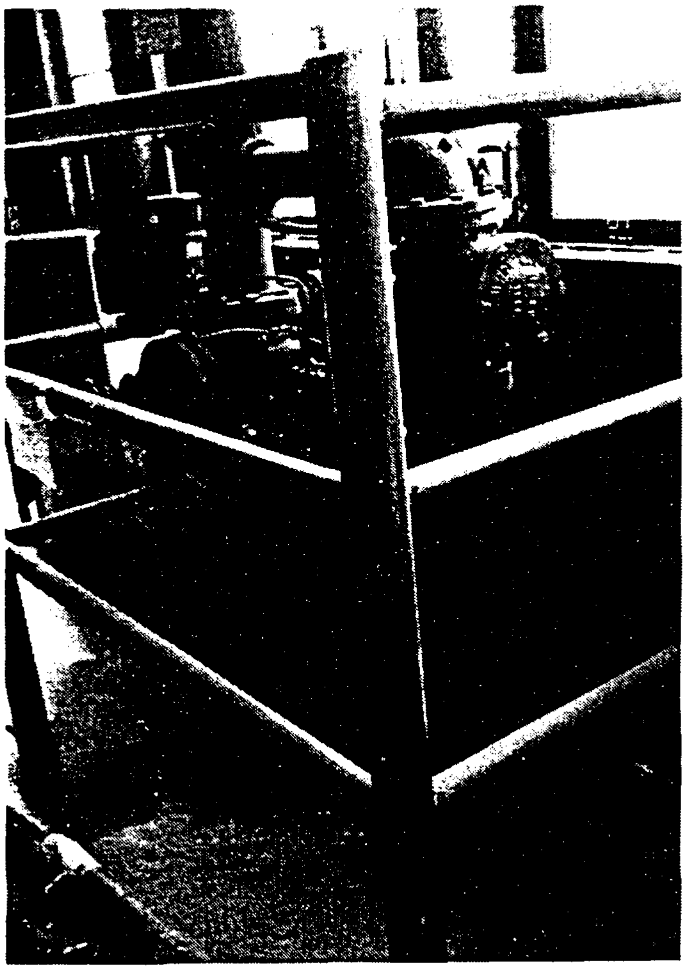

Figure 3.8. Typical Valve Station Riser at Oakland Naval Supply Center Which Suffered Soil-Induced Displacement Damage

In addition to the riser threaded elbow problems, there were various reports of sprinkler piping falling. While the problems discussed above may have contributed to system support failure, the Naval Supply Center used C-clamp supports (Figure 3.9) while none were found at the Oakland Army Base (which had no reported hanger failures). The C-clamp support is of interest given the information obtained from the NFPA 13 subcommittee Hearings (Ref. 3.2) following the Loma Prieta earthquake. During these hearings, several instances of C-clamp support failures were reported. Thus, while it cannot be ascertained whether the C-clamps contributed to the falling distribution piping (since all systems were rehung soon after the earthquake) it is a plausible contributing cause. Also of note were reports that, while the sprinkler piping came down, none of the fusible link heads opened.

The compiled data for the Naval Supply Center is not considered in the overall statistical analysis since the failures are believed to be primarily soil-induced.

Port of Oakland

The Port of Oakland stretches across 19 miles of shoreline from the mouth of the Oakland/Alameda inner harbor to the Oakland International Airport. Most of the port is on landfill.

There are approximately 300 buildings of which about 50 are fire-protected. Most of the fire protection systems were installed during original construction. A typical warehouse is shown in Figure 3.10. The port also leases airplane hangars to airlines using the Oakland Airport.

Overall facility performance was similar to the Oakland Army Base and Oakland Naval Supply Center. Numerous signs of soil liquefaction were evident and several buildings experienced severe settlement (Figure 3.11).

Three buildings suffered fire protection system damage. Two of the systems are in buildings which also suffered severe structural damage. These two buildings are scheduled for demolition. Neither building has been used since the earthquake.

One of the damaged buildings was the original headquarters for the Port but has since been used as a warehouse. The building is wood frame and was constructed in 1928 with the fire protection system installed during original construction.

The building is founded on piles driven into the harbor and sits over water. The building rests partially on shore on two adjacent sides. The piles settled during the earthquake and caused the building to pull away from the shore by two to three inches in one direction and approximately one inch in the other direction (Figure 3.12).

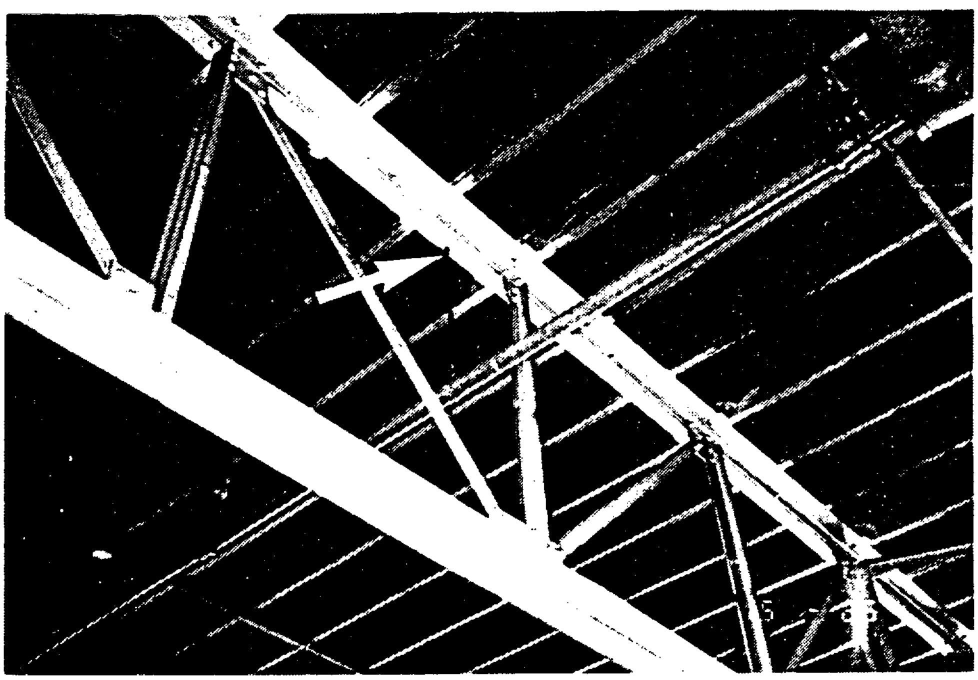

Figure 3.9. C-Clamp Support Used at Oakland Naval Supply Center

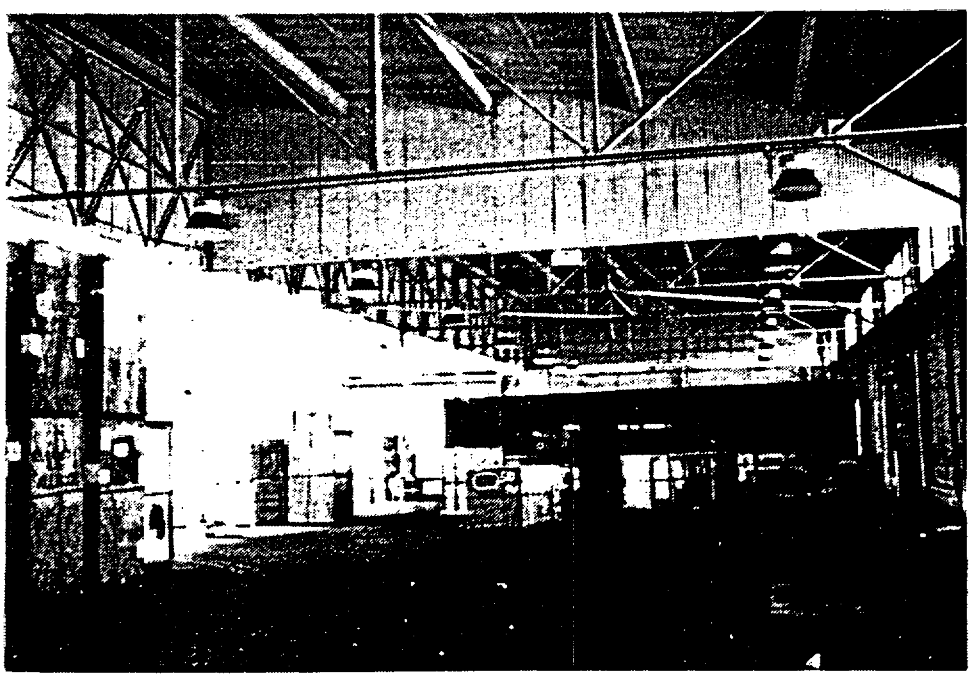

Figure 3.10. Typical Port of Oakland Warehouse

Figure 3.11. Severe Ground Subsidence at Port of Oakland

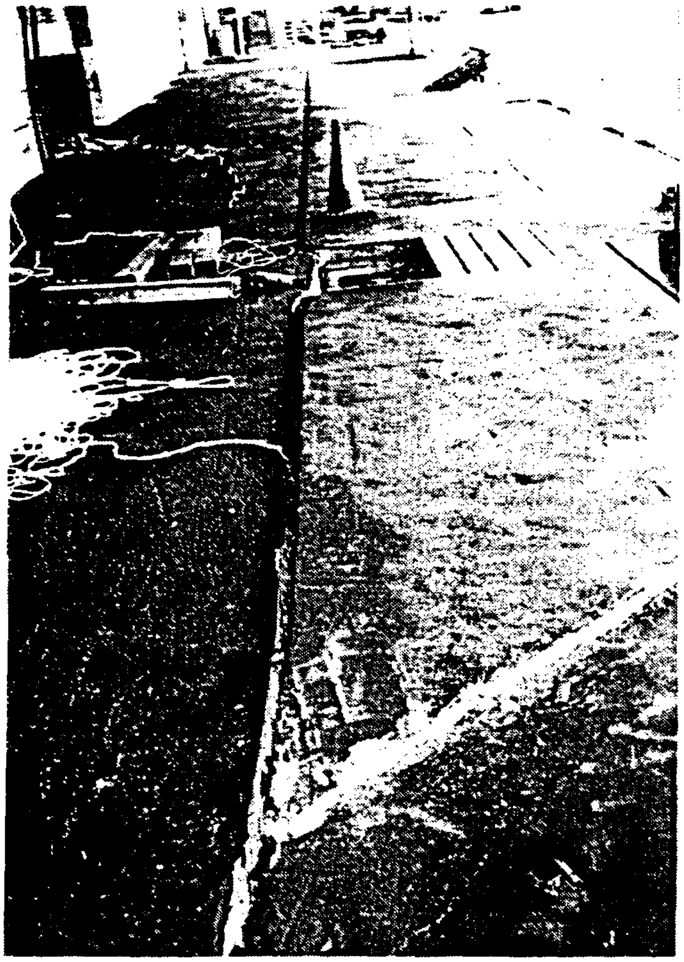

Figure 3.12. Settlement at Port of Oakland Warehouse Caused Building to Pull Away From Shore

The 10-inch diameter main feeding the building broke at a 45-degree flanged connection (Figure 3.13). The 10-inch main runs underground to the building, then runs suspended from the concrete base slab along the shoreline. The two ends of the broken pipe were separated by approximately one-quarter inch. This break was probably caused by the building displacement described above. As the building moved, the ground acted as an anchor at one end of the 10-inch pipe and the floor penetrations (completely filled) acted as an anchor at the building. Thus, the building displacement probably contributed to the 10-inch pipe break.

In addition to the 10-inch diameter main break, there was also a reported leak in a 6-inch diameter riser within the building. This leak, however, could not be identified since the system was shut down to repair the more significant 10-inch leak.

The two remaining buildings which experienced fire protection system damage experienced extensive structural damage (Figure 3.14). The structural damage included; displaced wood columns, sheared wood trusses, cracked concrete column bases, splintered roof diaphragm, and wood sill cracks running between anchor bolts. Both buildings have not been used since the earthquake and are scheduled for demolition.

The two fire protection systems performed similarly. In one of the buildings, there were 11 reported Victaulic type couplings failures. The couplings used were cut grooved. Overall, there was insufficient lateral bracing for the larger bore lines. The only non-Victaulic type coupling system problem was a leak in a 6-inch to 4-inch threaded reducing tee at the top of a feed line riser.

The only deluge fire protection systems at the Port are at Oakland International Airport hangars which the Port leases to various tenants. Four hangars have a total of 38 deluge systems with no reported actuations.

San Francisco International Airport

The San Francisco International Airport operates as the primary bay area airport. The airport is located 5 miles south of San Francisco with the bay to the east.

The San Francisco International Airport has approximately 80 protected structures. Telephone and site interviews were conducted with Airport Engineering Department personnel. The site is on the bay margins and is underlain by bay mud. A strong motion recording was obtained at the Airport and indicated a peak ground acceleration of 0.33 g. A response spectra for this record is shown in Figure 4.2.

Overall, these fire protection systems performed well in the Loma Prieta earthquake with the most extensive damage being that sustained to one of six boarding areas.

Figure 3.13. Break in 45° Elbow at Port of Oakland Resulting From Warehouse Settlement

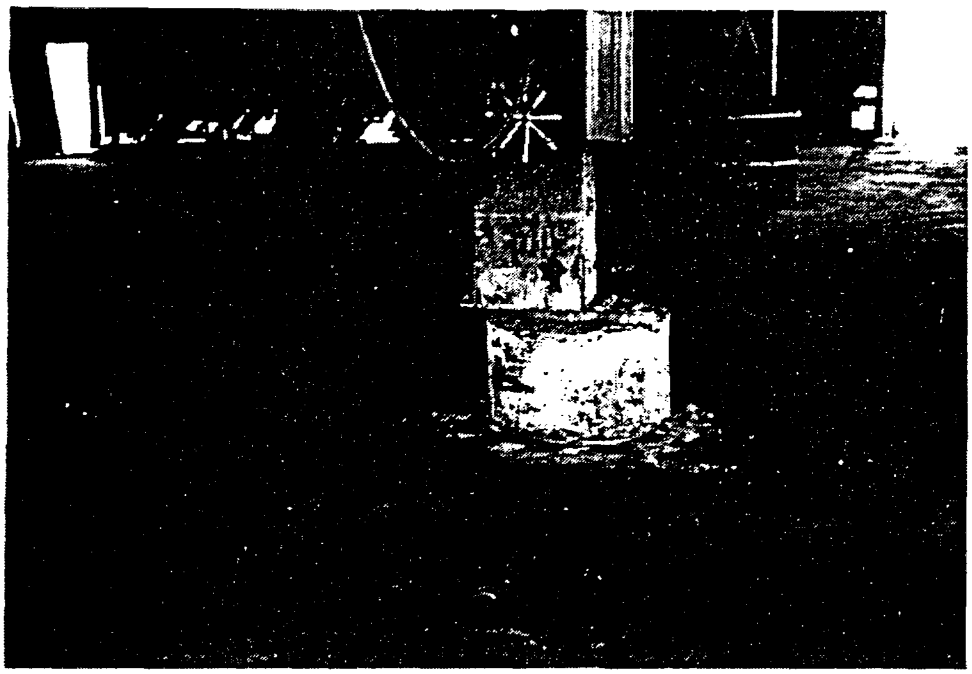

Figure 3.14. Displaced Column at Port of Oakland Wood-Frame Warehouse. Building is scheduled for demolition.

Various contributing factors produced the damage at the boarding area. Among the contributing factors; inappropriate use of plain end mechanical pipe couplings, inadequate lateral brace details, sprinkler heads sheared off, and rod hanger tensile failure. These failure modes are discussed in greater in length in Section 4.2.

The Airport also has dry fire protection systems which experienced no damage or system activations. In addition, there is a Halon fire protection system in the central terminal communication area which also experienced no problems.

The Airport Engineering Department is responsible for airport operated facilities but not for buildings leased to commercial airlines. Most of the leased buildings are cargo, hanger, or maintenance areas.

An estimated five additional problems occurred at leased buildings. The problems which occurred were in hanger-related facilities. None of these problems are known to have resulted in water release.

Treasure Island Naval Station and Hunters Point Naval Shipyard

The Treasure Island Naval Station is located in the San Francisco Bay north of Yerba Buena Island, the mid-span anchorage of the San Francisco-Oakland Bay Bridge (Figure 3.3). Hunters Point Naval Shipyard is located along the bay at the south-east corner of San Francisco. Both facilities are built on landfill. A strong motion recording at Treasure Island indicated a peak ground acceleration of 0.16 g. A response spectra for this record is shown in Figure 4.3.

Construction at Treasure Island is circa 1940 and primarily wood frame. Treasure Island also has several large reinforced concrete structures built for the 1939 Worlds Fair.

Hunters Point Naval Shipyard had eight protected structures and did not experience any fire protection system problems from the Loma Prieta earthquake. The problems experienced at Treasure Island are discussed below.

Throughout Treasure Island there were numerous instances of soil liquefaction. Reported problems resulting from the soil liquefaction include telephone poles falling, a portion of the seawall rotating seaward, building settlement, and differential settlement of concrete slabs (up to 9 inches).

There are 26 fire protection systems in structures on the Treasure Island base. The only deluge fire protection system at Treasure Island experienced no problems. The deluge system consists of seven deluge valves and was installed during original construction in 1943.

A concrete aircraft hangar used as a training site for the Naval and Marine Reserves had one reported fire protection system problem and also suffered structural damage. The building suffered severe differential settlement of concrete slabs (up to 6 inches) and settlement of associated wall partitions and doors. In addition, there were minor cracks and deformations of wood and steel structural members.

The one reported fire protection system failure at the aircraft hanger was a 1-inch diameter riser which broke at a threaded connection between two rigid supports. The lower support was connected to a concrete wall while the upper support was tied to a steel deck supporting hanger lights. The break was apparently caused by differential movement of the two adjacent support points.

Two more failures occurred in a structural steel and concrete building used for training, ship maintenance, and as the post office and fire station. The building has reinforced concrete appendage structures on three sides and a frame structure on the fourth side. Once again, there was differential displacement of the concrete slabs and minor damage to the structural steel and wood bracing on trusses and wall systems.

The first fire protection system failure was the opening of a Victaulic-type mechanical coupling on an 8-inch diameter pipe riser. The 8-inch pipe also suffered an underground break directly below the coupling failure. The proximity of the underground break to the coupling failure may indicate the failure was contributed to by soil-induced pipe displacement.

The second documented failure was a 2-inch diameter pipe leak, the location of which could not be identified during the site visit.

<u>Moffett Field Naval Air Station</u>

Moffett Field Naval Air Station is located at the south end of the bay in the Mountain View/Sunnyvale area. The base is partially on landfill. No structures were affected by the landfill conditions, however, since only runways are built on the fill.

A strong motion recording was obtained at Colton Avenue, Sunnyvale with a peak ground acceleration of 0.22 g. A response spectra for this record is shown in Figure 4.4.

Moffett Naval Air station has approximately 625 buildings of which 45 percent (281 buildings) were estimated to be fire protected. The construction ranges in age from 1933 to present. The fire protection systems were built to prevailing NFPA codes.

Moffett Field experienced no problems with their fire protection systems in the Loma Prieta earthquake. Nine buildings have deluge fire protection systems. There were no actuations of any of the nine systems.

The base experienced some structural damage. Two buildings have been condemned. Neither of these buildings had fire protection systems. Total cost of structural damage was estimated at $15 million. In addition, the base suffered underground gas and water main leaks.

Moffett Field also has 10 Halon and 10 carbon dioxide systems. These systems are used to protect paint storage, computer centers, and training centers. There were no reported actuations or problems with these systems.

Lockheed

Lockheed has steadily grown since it began operation in 1953 with its facilities spread throughout the south bay area. The total number of facilities is estimated at 300 for the Sunnyvale, San Jose, Milpitas, and Santa Clara areas with 20 additional buildings in Palo Alto.

While the fire protection systems at Lockheed are predominantly wet, there are also approximately 10 deluge fire protection systems. No deluge valve actuations were reported. The Lockheed facilities also have "numerous" Halon and carbon dioxide systems. Once again, there were no reported problems with either types of systems.

Overall, the Lockheed facility fire protection systems performed well in the Loma Prieta earthquake. The fire protection systems were designed to prevailing NFPA codes. The only reported instance of damage for the Lockheed facilities occurred at a two-story wood frame/stucco building in Palo Alto (Figure 3.15). The building is currently undergoing seismic upgrades.

A strong motion recording was obtained at the Palo Alto Veterans Hospital, approximately two miles from Lockheed's Palo Alto complex. The peak ground acceleration was 0.38 g. A response spectra for this record is shown in Figure 4.5. A large number of the Lockheed facilities are near the Colton Avenue, Sunnyvale record described above (Figure 3.4).

The reported failure was a break in a 6-inch diameter threaded elbow. The 6-inch diameter line rises through the first floor penetration and spans across the first floor ceiling. The break occurred at the elbow where the 6-inch main runs up through the second floor penetration. The second floor penetration was completely filled. The lack of pipe clearance and apparently poor building performance (requiring seismic upgrades) may have contributed to the threaded elbow failure.

Hospital Facilities

Reviews were performed of engineering and damage survey reports from post-earthquake inspections of bay area hospitals (Ref. 3.3). Approximately 90 state, county, and private hospital facilities and offices were inspected for damage by the office of Statewide Health Planning and Development and by private engineering organizations. In addition, private communications with selected personnel were conducted. The facilities involved cover the counties of Alameda, San Francisco, San Mateo, Santa Clara, and Santa Cruz.

The hospital facilities include a wide range of structural types, ages, and distribution throughout the affected bay area. The ages of the

Figure 3.15. Lockheed's Palo Alto Building Experienced Structural Damage in Addition to 6-Inch Diameter Threaded Elbow Failure

structures range from post-1906 in San Francisco to modern structures (Figure 3.16). Several older (pre-1973) non-conforming structures sustained various degrees of damage to reinforced concrete and unreinforced masonry. One hospital was "redtagged" as a possible collapse hazard and others were posted "Limited Entry." Much of the damage consisted of cracking of concrete and nonstructural damage to elevators, lights, tanks, equipment and water lines. About two-thirds of the structures were located in San Francisco and Oakland and associated with ground motions of about 0.1 g. The balance of the facilities were located in areas with ground motion between 0.2 to 0.4 g.

Only one instance of fire protection system failure was reported. This was at O'Conner Hospital in San Jose and was initiated by the failure of sprinkler supports installed into a sheetrock ceiling.

<u>Hewlett Packard</u>

Hewlett Packard (HP) is a major designer and manufacturer of electronics. They have over 40 facilities which were affected by the Loma Prieta earthquake. Telephone interviews with engineering and facilities personnel were conducted to determine the performance of their fire protection systems. These were also supplemented by reports on the major damage. HP reported no fires and therefore had no demand placed on its fire protection system.

Hewlett Packard occupies about 23 structures on three sites in the Palo Alto area (Figure 3.4). These structures are all close to the seismic record at the Palo Alto Veterans Administration Hospital which recorded a peak ground acceleration of 0.38 g. A response spectra for this record is shown in Figure 4.5. Two failures were reported in the Palo Alto area. Both involved damaged to sprinkler heads.

The one major failure in Palo Alto was associated with differential motion between independent structures. The structures were of substantially different stiffness; one steel frame and the other reinforced concrete. Piping crossing these separations were distressed. Damage and water release were mostly due to impact of small branch lines with structural members which resulted in the failure of 16 sprinkler heads.

Hewlett Packard also occupies about 20 other structures including offices and warehouses located in Cupertino, Santa Clara, San Jose, and Sunnyvale. These areas were characterized by MMI ground motion intensity of 7 and many strong ground motion recordings between .15 to .2 g. Two failures were reported in San Jose. One was to a process water line. The other was to sprinkler heads in a warehouse.

One of the large HP facilities was also equipped with backup diesel powered pumps. Four pumps, two large and two small, provide backup capability along with a 150,000-gallon water tank. Other fire protection installations include three Halon systems. One is a single room system. The other two are small, in-equipment installations. These

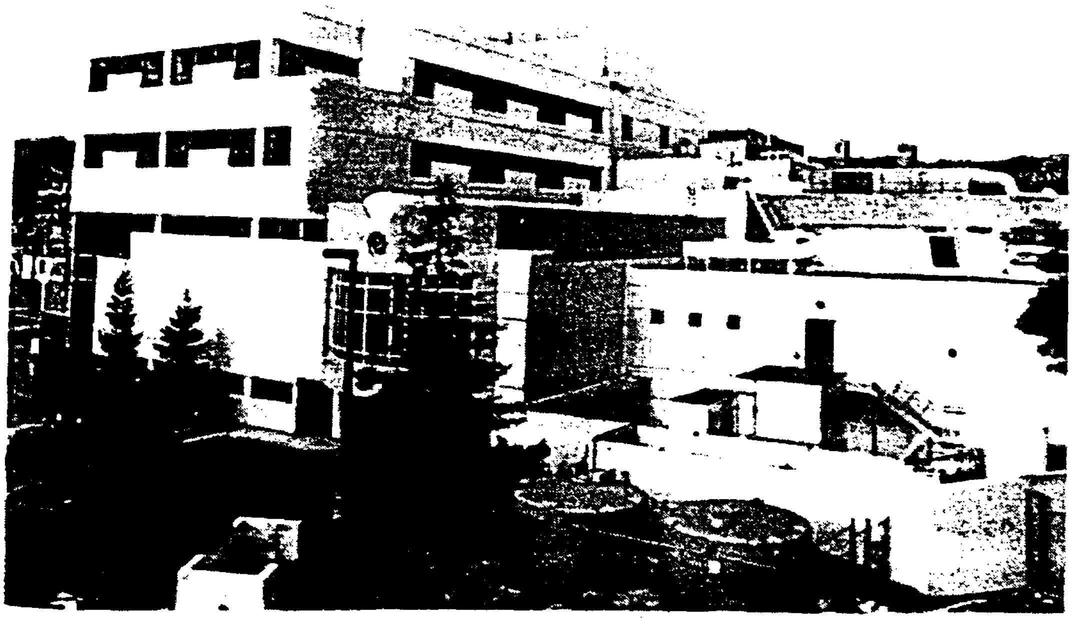

Figure 3.16. Main Hospital Building, Children's Hospital, Oakland, California

systems were located in Palo Alto where ground motions were 0.38 g. They have redundant smoke detectors and were not subject to actuation.

Seagate Technology Disk Drive Plant

The town of Watsonville appeared to be the center of serious damage from the earthquake. A small industrial park of light manufacturing facilities, machine shops, and office buildings is located on the northwest side of town. One of the larger and more recent facilities is a computer disk drive assembly plant operated by Seagate Technology.

The disk drive plant is housed in a concrete tilt-up building covering over 20,000 square meters in adjoining one- and two-story sections. The main building suffered minor cracking occurring in a few of the exterior concrete wall panels as well as in interior partitions. One example of water intrusion into electrical equipment was documented at this site. Threaded couplings in fire sprinkler lines cracked at two locations within the main building, both in short interconnections between long horizontal runs of rod-hung line. A total of seven fire sprinkler heads were broken due to impact with adjacent wooden ceiling beams (Figure 3.17). The building contains over 1000 ceiling-mounted fire sprinklers, so this in fact represents a very small fraction of failure. At most locations, damage from the resulting water spray was easily cleaned up. However, one sprinkler head broke above an indoor unit substation, a transformer and switchgear assembly supplying 480 V ac power to the production areas (Figure 3.17). Water spray onto the unit substation required that it be disassembled, dried out, and reassembled before it could be energized, a process that took several days. The site lost power at the time of the earthquake, so there was little threat of electrical fire.

3.2 Halon and Carbon Dioxide Fire Protection Systems

Our review of Halon and carbon dioxide (CO_2) system performance included discussions with fire protection and engineering personnel at sites visited, telephone surveys of safety personnel at private companies, discussion with fire protection industry people representing engineering organizations, insurance carriers, fire suppressant manufacturers and their representatives, and codes and standards members.

Data on Halon and carbon dioxide fire protection system performance during the Loma Prieta earthquake was compiled primarily by telephone interviews with private companies located in the South Bay area. These sites were predominantly in areas of MMI 6 to 7 and correspond to ground accelerations from 0.1 to 0.2 g. Table 3.1 provides a summary of the data collected.

Through our investigations, we found no reported instances of Halon or CO_2 fire protection system damage or actuations from the Loma Prieta earthquake.

Figure 3.17. In One of the Auxiliary Substation Rooms, a Fire Sprinkler Head Failed Upon Impact with Nearby Ceiling Beams (upper photo). Water sprayed into the unit substation below (lower photo), which required disassembly and dry out.

Table 3.1

Summary of Halon and CO_2 Installation Survey

Facility or Company	Number and Type of System	Performance
Xerox	1 Halon	No Problems
Advanced Micro Devices	2 Halon	No Problems
VLSI Technology	1 Halon	No Problems
Applied Materials	1 Halon	No Problems
Signetics	6 Halon	No Problems
Intel	6 Halon, 4 carbon dioxide	No Problems
Micro Power Systems	3 Halon	No Problems
Cypress Semiconductor	1 Halon, 3 carbon dioxide	No Problems
Measurex	5 Halon	No Problems
Siliconix	2 Halon, 2 carbon dioxide	No Problems
Spectra Physics	30 Halon, 6 carbon dioxide	No Problems
Hewlett Packard	3 Halon	No Problems
NAS Moffett	10 Halon, 10 carbon dioxide	No Problems
San Francisco Airport	1 Halon	No Problems
Totals	72 Halon, 25 carbon dioxide	

Representative Halon and carbon dioxide fire applications include protection for gaseous and liquid flammable materials, electrical hazards (transformers, oil switches, circuit breakers), hazardous solids, and computer and control rooms.

The seismic performance of Halon and CO_2 fire protection piping is enhanced by the design requirements in the NFPA standards. NFPA 12A (Ref. 3.4) requires Halon piping design in accordance with ASME B31.1 Power Piping Code (Ref. 3.5). Notably, this code includes consideration of seismic (occasional) loadings. The NFPA standard also includes internal pressure considerations. Design calculations require a minimum internal pressure of 620 psig (360 psig charging pressure) to 1000 psig (600 psig charging pressure) or greater.

Halon piping seismic performance is aided by these design provisions. The internal pressure design provides a safety margin since internal pressure during a seismic event is atmospheric (open heads). In addition, system design requires restraint to accommodate agent thrust forces. These additional restraints, especially on small diameter branch lines, result in improved seismic performance. NFPA standards and industry practice includes the test discharge of gas suppressant systems prior to placement in service. System discharge tests provide a level of shakeout of systems by subjecting them to dynamic agent thrust loads. Inadequate piping system support or installation deficiencies may result in damage during these tests. This testing therefore provides a degree of design verification not found in the acceptance of water suppression system installed to NFPA-13 (Ref. 3.6). Finally, gaseous piping, like dry fire protection systems, have lower inertial than those for wet fire protection systems which have additional water mass.

There were no reported leaks of Halon or CO_2 from storage tanks or cylinders. Smaller gaseous systems are charged from pressurized cylinders. Larger systems can have manifolded cylinders or refrigerated storage tanks. Many vendors supply restraining straps for cylinders and NFPA 12A requires that storage containers be "securely mounted."

The majority of the data on Halon and CO_2 systems is distributed within the Santa Clara and San Jose area which is characterized by ground-motion recordings between 0.15 and 0.25. A few of the site are located near ground-motion records greater than 0.3 g.

Due to the absence of damage, a high confidence of a Low Probability of Failure (HCLPF, a 95 percent confidence of 5 percent failure can be inferred to lie at a peak ground acceleration of greater than a quarter "g."

3.3 References

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4.0 FIRE PROTECTION SYSTEM PERFORMANCE AND EARTHQUAKE DATA ANALYSIS

4.1 Strong-Motion Recordings

Six strong-ground motion accelerographs were selected as representative of the data collection sites. Several of these sites are located at or very close to the sites investigated. These include Treasure Island, Oakland Outer Harbor, San Francisco International Airport, and Palo Alto Veterans Hospital records (Figures 4.1 through 4.6). Other sites were selected which are either close to some of the data sites or which are believed to have similar ground motions for a region with distributed data points. The later includes the Colton Avenue record which lies within two miles of the Naval Air Station Moffett Field, Lockheed, and is believed to be an adequate representation of motion in the west Santa Clara and San Jose area. The San Francisco Diamond Heights record was selected to represent approximately 30 California hospital facilities located near rock sites in San Francisco and a number of other hospital sites in areas of MMI 6 intensity.

4.2 Failure Modes

The first step in the development of a fragility model is to develop a definition of what constitutes failure for a fire protection system. For the wet system investigated, many types of damage were observed.

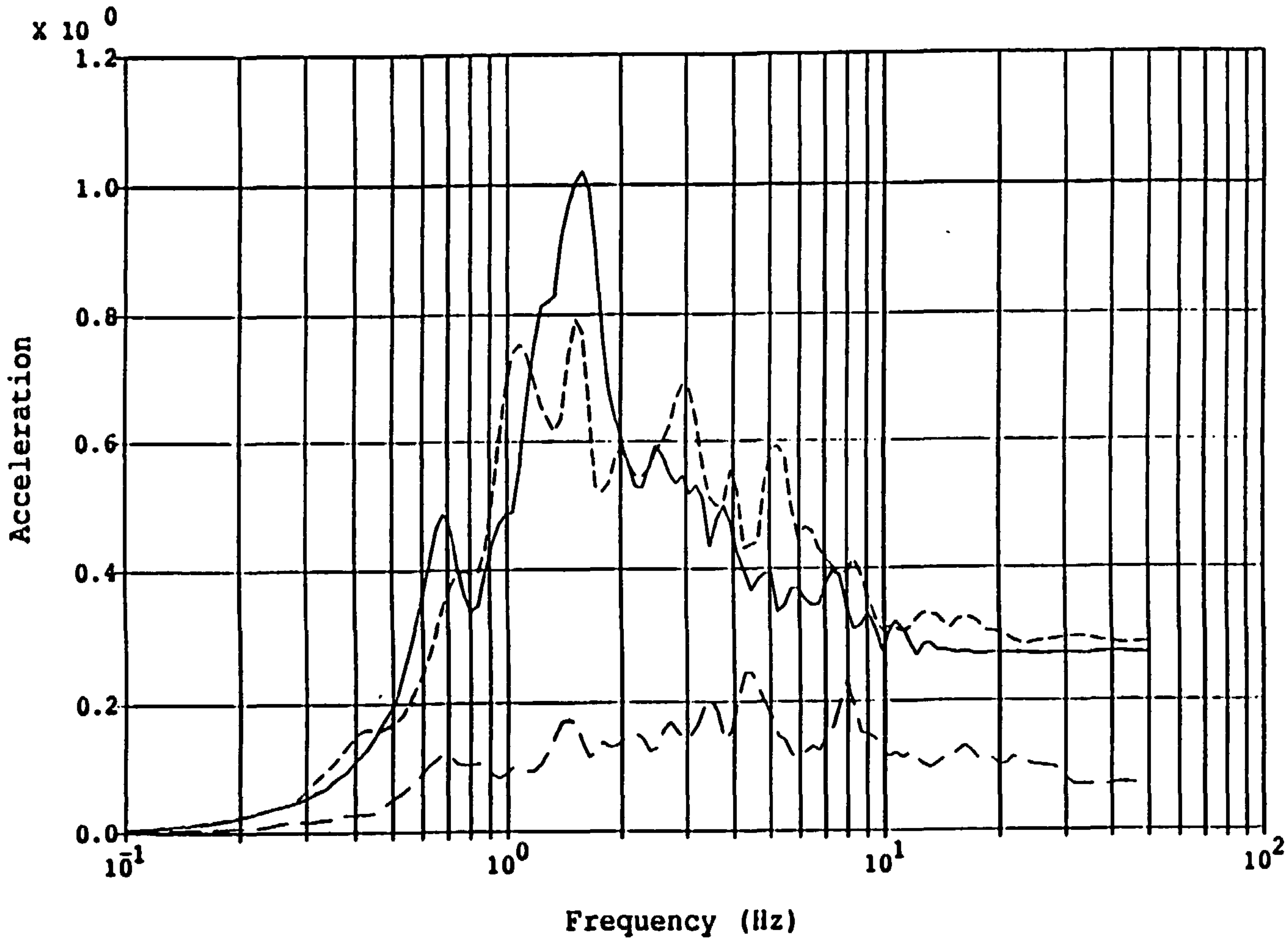
The most visible fire protection system impairment has been to fire sprinkler piping and the most commonly reported causes both in this Loma Prieta and earlier studies (Ref. 4.1) are discussed below:

Sprinkler Head Damage

Sprinkler heads are one of the most vulnerable components in fire protection installations. Damage to heads results from impact with building structural and architectural features. This type of system damage has been reported in every major earthquake since 1964 Alaska. Current NFPA-13 design provisions do not require branch restraint or field review to preclude this form of damage. A second cause of sprinkler head damage results from the interaction of sprinkler heads with sheetrock and to a lesser extent recessed T-bar type ceilings. Sheetrock ceilings acting as a restraint point where sprinkler heads penetrate this restraint of flexible fire protection mains can result in branch piping failures. Failures of inadequately supported recessed ceilings are common in moderate to strong ground motion. Sprinkler head escutcheons in these types of ceiling tend to drag and may actuate heads resulting in system failure.

Branch Line Failures

Uplift of branch lines supported by U-hooks from flexible diaphragm roof and floors have been a frequent occurrence. Uplift of the lines and impact of sprinkler heads has been reported in the San Fernando,



Legend:

Horizontal (305 Deg) ————————

Vertical — — — — —

Horizontal (35 Deg) ---------

Notes:

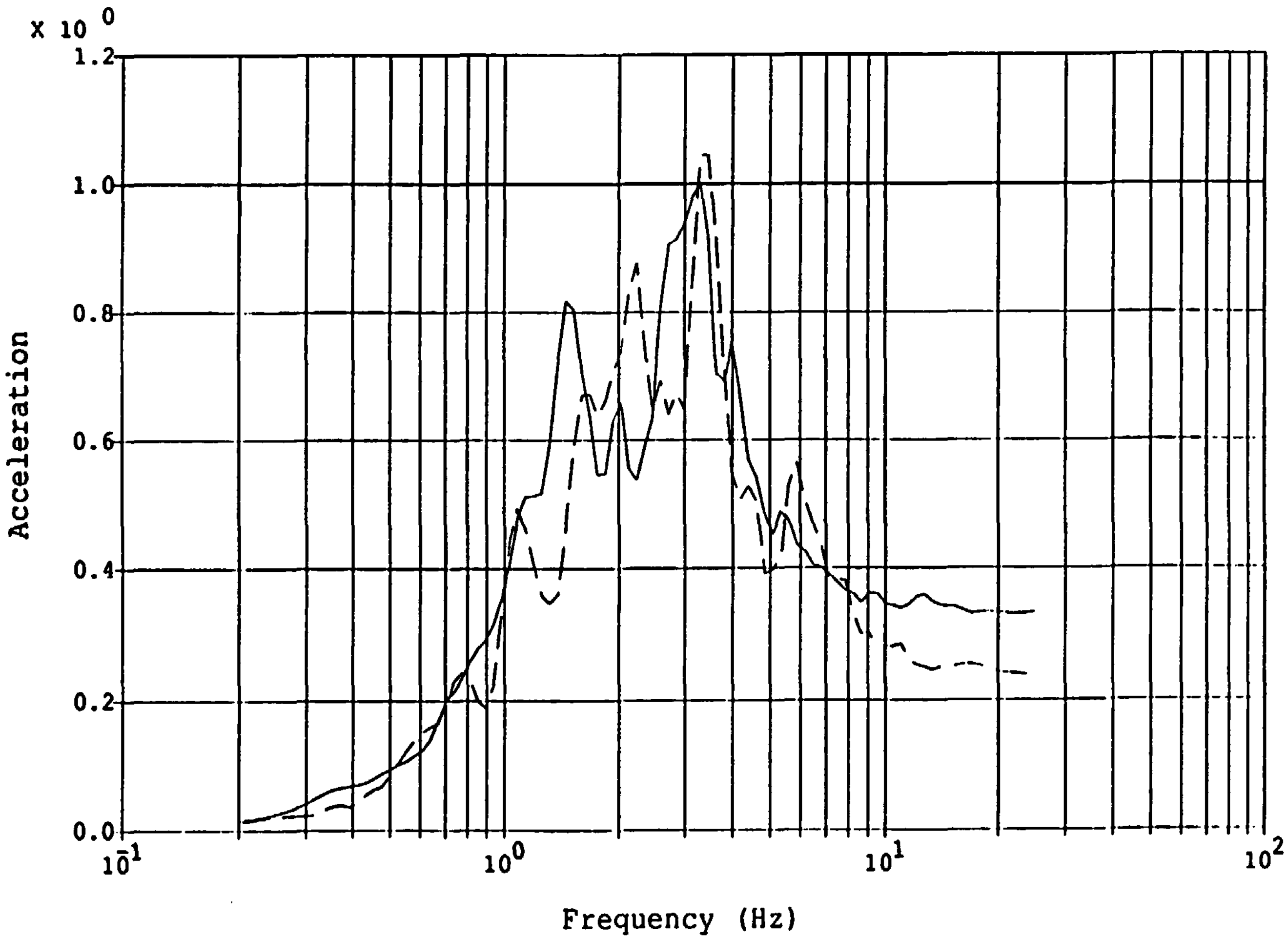
5% Spectral Damping

Based on USGS Interim Set 1 Corrected Accelerogram Records

Accelerations in g's

Timestep: 0.: 20 Seconds

Figure 4.1. Response Spectra From Loma Prieta Earthquake: In-Structure Record From Oakland Outer Harbor Wharf



Legend:

90 Deg. Component ————————

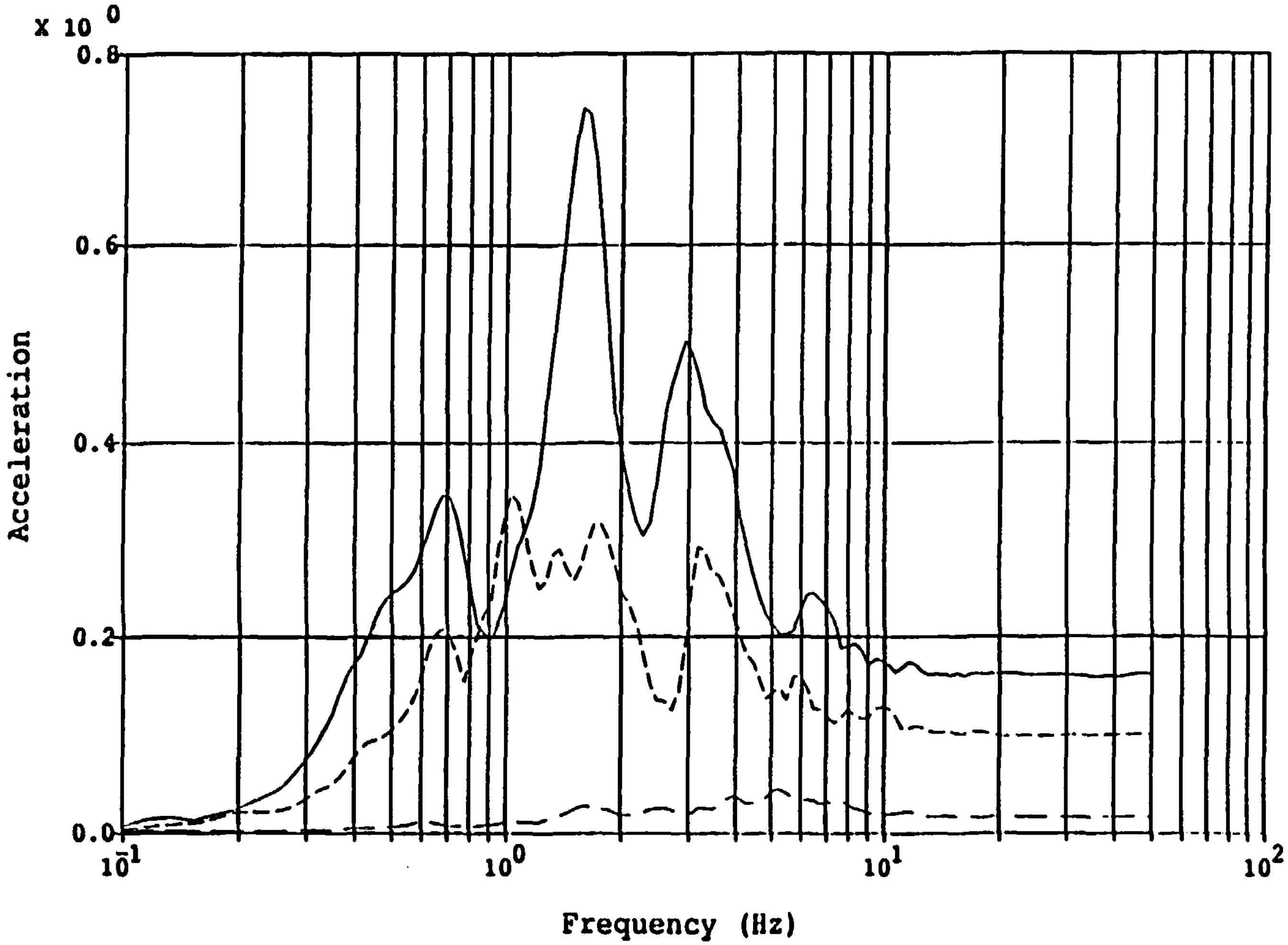
0 Deg. Component — — — — — —

Notes:

Acceleration in g's

5% Spectral Damping

Figure 4.2. Response Spectra from Loma Prieta Earthquake: Freefield Record From San Francisco International Airport



Legend:

Horizontal (90 Deg) ————————

Vertical — — — — — —

Horizontal (0 Deg) - - - - - - - - -

Notes:

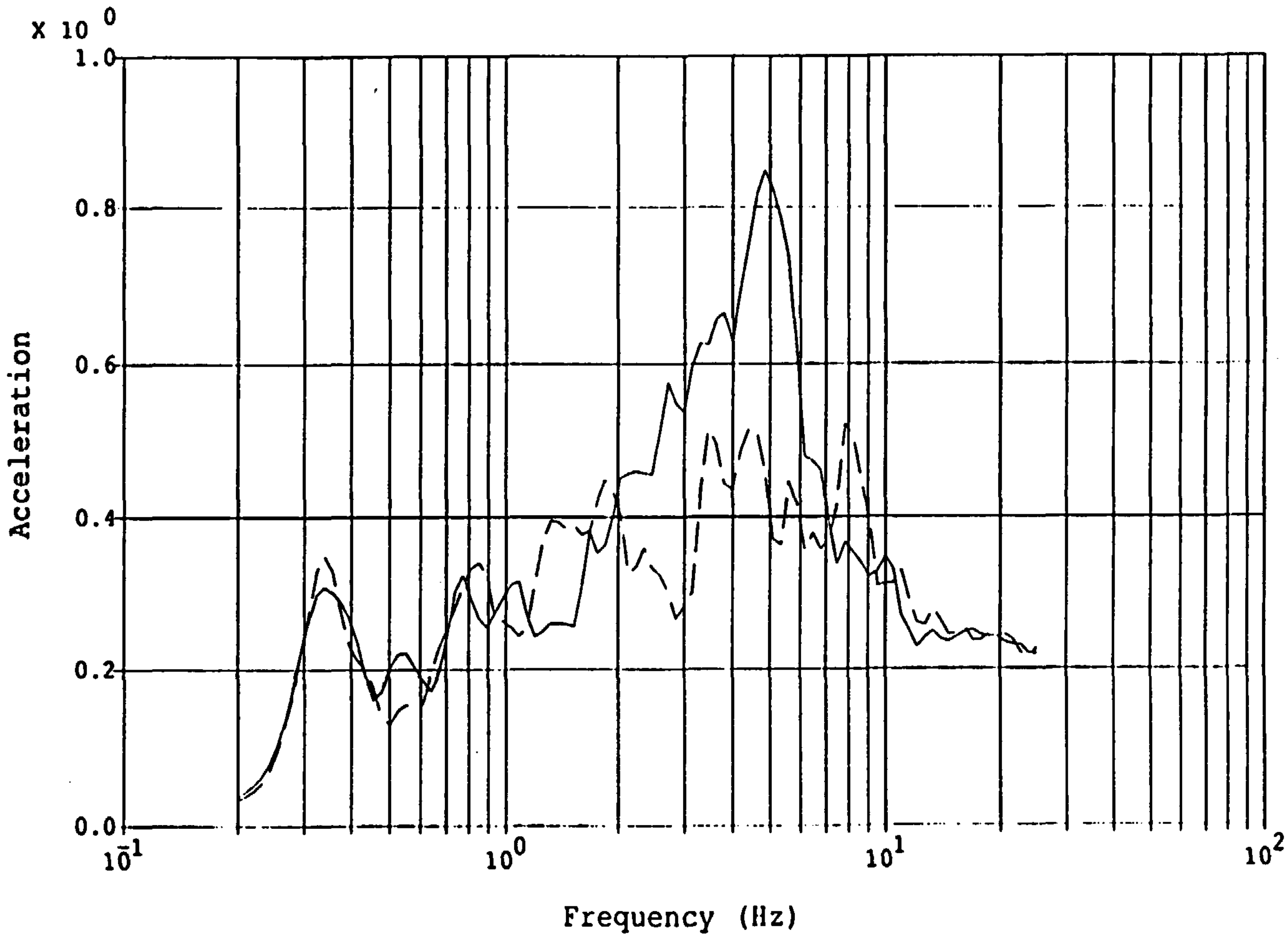
5% Spectral Damping

Based on USGS Interim Set 1 Corrected Accelerogram Records

Accelerations in g's

Timestep: 0.020 Seconds

Figure 4.3. Response Spectra From Loma Prieta Earthquake: Freefield Record From Treasure Island



Legend:

360 Deg. Component ————————

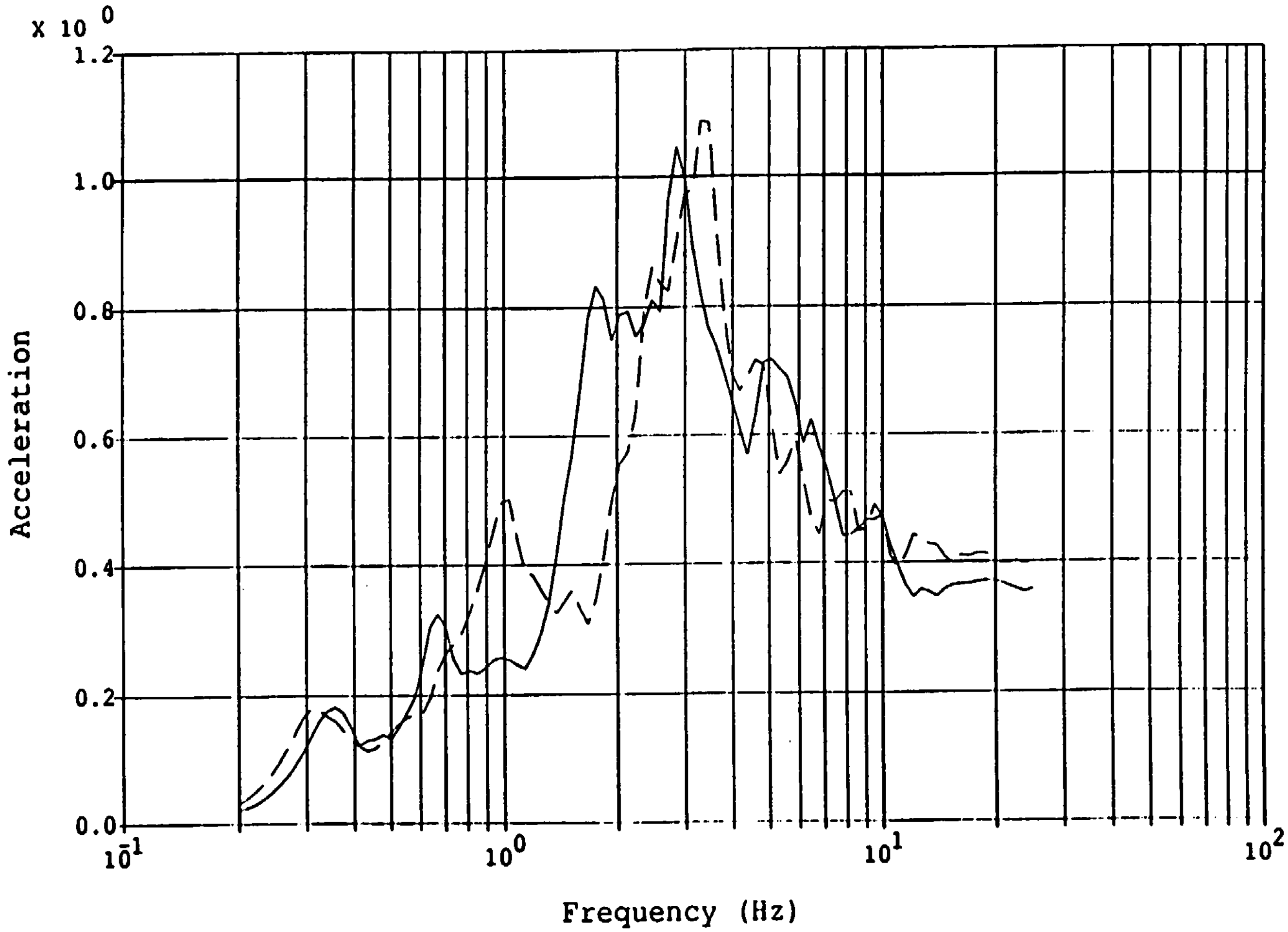
270 Deg. Component — — — — —

Notes:

Acceleration in g's

5% Spectral Damping

Figure 4.4. Response Spectra From Loma Prieta Earthquake: Freefield Record From Colton Avenue, Sunnyvale



Legend:

302 Deg. Component ————

212 Deg. Component — — — — —

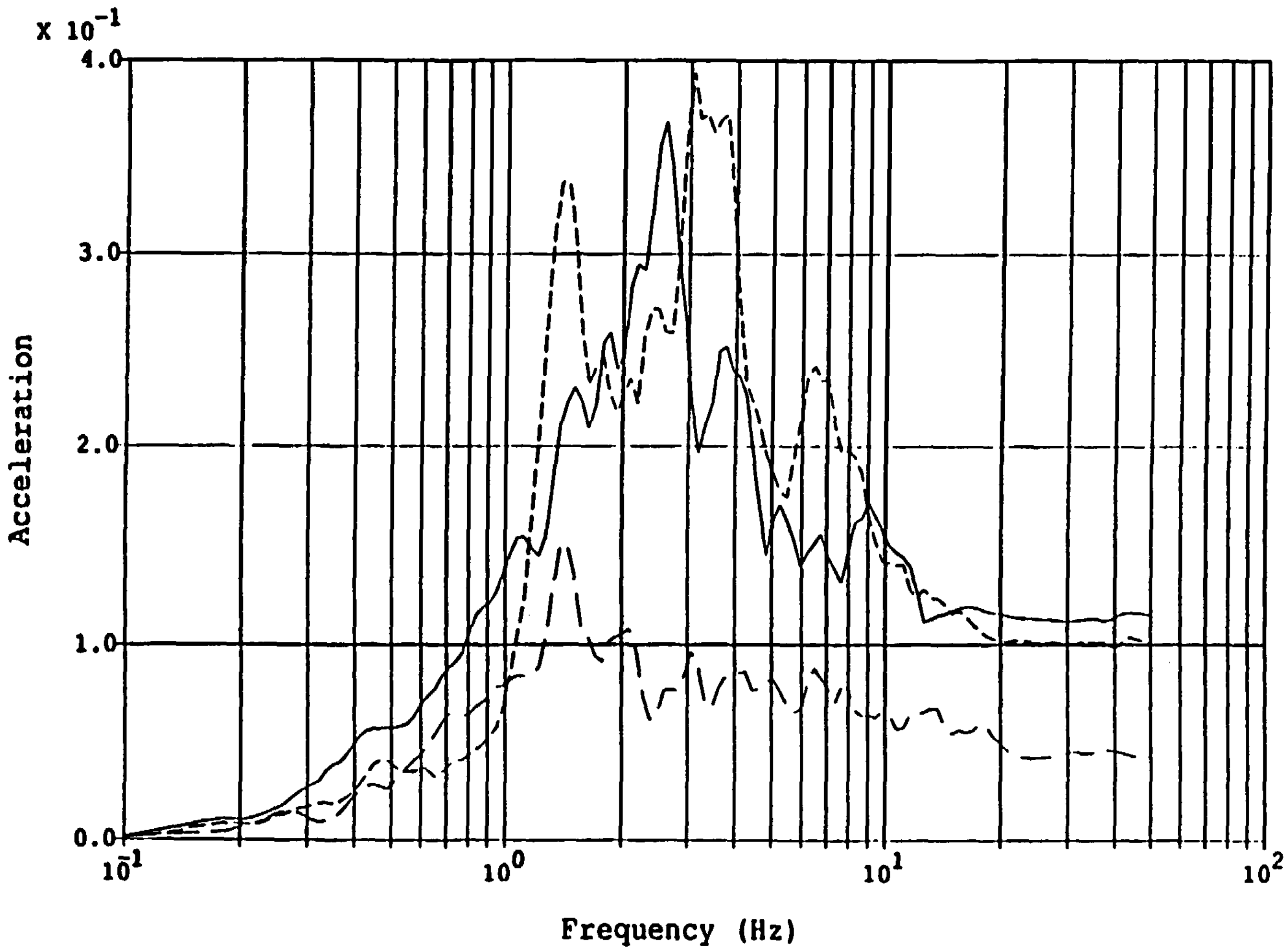
Notes:

Acceleration in g's

5% Spectral Damping

Figure 4.5. Response Spectra From Loma Prieta Earthquake: Basement Record From Veterans Administration - Palo Alto

Figure 4.6. Response Spectra From Loma Prieta Earthquake: Basement Record From San Francisco Diamond Heights



Legend:

Horizontal (90 Deg) ————————

Vertical — — — — —

Horizontal (0 Deg) ---------

Notes:

5% Spectral Damping

Based on USGS Interim Set 1 Corrected Accelerogram Records

Accelerations in g's

Timestep: 0.020 Seconds

Whittier, and Loma Prieta earthquakes. Branch line failures have also resulted where support attachment to overhead beams was provided using C-type clamps without positive restraining ties. C-clamps without restrainers have a tendency to "walk" under dynamic loads.

Inadequate Flexibility

Many piping configurations have failed due to designs with inadequate flexibility to accommodate relative building motions. These include inadequate clearance around floor penetrations, inadequate flexibility between independent structures and restraint of branch lines with inadequate flexibility to main headers.

Anchorage Failures

Both overhead and sway braces have failed due to poor design and construction practices. Power driven fasteners are the most commonly reported cause of anchorage failure. Supports which have eccentric load paths to the structure result in prying loads which the systems are not designed to accommodate. Short threaded rods have exhibited fatigue failures due to repetitive lateral loadings. These types of failures lead to pressure boundary failures only in rare cases.

Underground Mains

In areas where soft soil conditions can result in liquefaction, underground water lines are frequently broken. Cases have also been reported where uplift of mains has broken interior fire protection piping.

Other Earthquake Effects on Fire Protection Systems

Review of testimony at the NFPA-13 subcommittee Hearings (Ref. 4.2) and reports from the 1971 San Fernando Earthquake (Ref. 4.1) both indicate that large numbers of earthquake related signals were received by city central stations and dispatch centers. Signals were received from water sloshing in tanks and broken foil-protected windows. Detection light beams and door contacts were jarred, and transmitting devices were impaired by severe shaking. These patterns of false alarms and genuine fire calls produced considerable uncertainty in establishing emergency priorities.

The definition of failure adopted for this study is damage to the pressure boundary of the system or inadvertent actuation which results in fluid release. Fluid release which results from structural damage or failure and damage due to soils-related causes are excluded.

Based on this definition, fire protection system failures resulting from only the first three categories were compiled for the sites investigated.

4.3 Engineering Damage Measures

Numerous engineering damage measures have been proposed and studied in the literature. Both empirical scales such as MMI and analytical parameters have been used. Several analytical indicators were selected for investigation and comparison with the observed damage data. Four indicators were selected and included: (a) Peak Ground Acceleration (PGA)--the most widely utilized, (b) Arias Intensity--a measure of energy, (c) Cumulative Average Velocity (CAV)--the proposed measure for OBE Exceedance, and (d) Peak Ground Displacement (PGD).

These four indicators were either taken directly (in the case of peak values) from the six strong-motion records, or were calculated utilizing the procedures described in Reference 4.3. Values for each indicator are shown in Table 4.1, along with values for a Regulatory Guide 1.60 earthquake (from Ref. 4.3) and selected values calculated for the 1971 San Fernando Earthquake.

A comparison of CAV and Arias Intensity for the six records show the Colton, Palo Alto VA, San Francisco Airport, and Oakland Harbor values fall within a close range to the RG 1.60 values. CAV values range from about 0.7 to 1.0 and Arias Intensity from about .04 to .06. PGA values have a wider range from 0.2 to 0.4 g. All records from 12 Loma Prieta records and the two San Fernando records fall substantially below the peak ground displacement measure for the RG 1.60 earthquake.

Response spectra for the twelve seismic records are shown in Figures 4.1 through 4.6. Most of these records show significant high frequency response filtering due to local soil conditions and attenuation at large distance form the earthquake epicenter. These records also show significant amplified response in the mid-frequencies. Fire protection sprinkler systems designed in accordance with the requirements of NFPA-13 tend toward frequencies in the 1 Hz to 4 Hz range. The amplified response spectra for the data sites studied are believed to provide an adequate test in these frequencies.

It is concluded that the greater 8 of the 12 records reasonably envelope a 0.2 g R.G. 1.60 SSE event with the exception of peak ground displacement. The lowest four of the 12 records are a believed to be reasonably representative of 0.1 g R.G. 1.60 OBE event with the exception of peak ground displacement. The proposed OBE exceedance criteria of any one of the three component CAV values exceeding 0.3 g-sec is easily met for the Treasure Island record and the San Francisco Diamond Heights record has a value of 0.29 g-sec.

Correlation of Damage Data

Performance data for each of the sites investigated was categorized by each of the four engineering damage measures discussed above. The data collected represented a wide range of structural types, site and soil condition, and vintage of structures and fire protection systems. In addition, the sizes of site data samples varies by an order of magnitude

Table 4.1

Comparison of Loma Prieta With 1971 San Fernando and Regulatory Guide 1.60

Location	PGA (g)	CAV (g-sec)	Displ (cm)	Arias (Intensity) (g^2-sec)
Loma Prieta				
Colton Avenue	0.22	0.97	13.8	0.051
	0.21	0.88	12.6	0.043
Palo Alto	0.35	0.76	8.6	0.049
Veterans Hospital	0.39	0.78	10.0	0.053
San Francisco Airport	0.33	0.77	5.9	0.059
	0.24	0.81	5.0	0.056
Oakland Harbor	0.27	0.78	9.2	0.064
	0.29	0.64	9.9	0.047
San Francisco	0.11	0.25	4.3	0.007
Diamond Heights	0.10	0.29	2.8	0.009
Treasure Island	0.16	0.40	12.2	0.023
	0.10	0.29	4.5	0.009
R.G. 1.60	0.20	0.835	18.3	0.060
1971 San Fernando Earthquake				
Hollywood Storage	0.21	0.742	14.7	0.040
Van Nuys Holiday Inn	0.25	1.19	14.9	0.080

implying a wide range of confidence level in each individual data set. Therefore, the consolidation of multiple data sets into groups by ground motion indicator tends to smooth the effects of small data sets results and increase the confidence level of the grouped data. The data sets are shown with a distribution by peak ground acceleration in increments of one-tenth of a g in Table 4.2.

The best correlation of the data were found to be with peak ground acceleration. To a much lesser extent with Arias energy and to be poor with CAV and displacement. A plot of damage fractions versus peak ground acceleration is shown in Figure 4.7.

4.4 Fragility Model

Given that the best correlation obtained between fire protection system damage was with peak ground acceleration, a traditional fragility characterization was developed.

The entire fragility family for the fire protection piping corresponding to the observed failures mode can be expressed in terms of the best estimate of the median ground acceleration capacity, A_m, and two random variables. Thus, the ground acceleration capacity, A, is given by

$$A = A_m \varepsilon_R \varepsilon_U ,$$

in which ε_R and ε_U are random variables with unit medians, representing, respectively, the inherent randomness about the median and the uncertainty in the median value. In this model, we assume that both β_R and β_U are lognormally distributed with logarithmic standard deviations, B_R and B_U, respectively. The formulation for fragility given by this equation and the assumption of lognormal distribution allow easy development of the family of fragility curves which appropriately represent fragility uncertainty.

With perfect knowledge (i.e., only accounting for the random variability, B_R), the failure fraction, f_o, for a given peak ground acceleration level, a, is given by

$$f_o = \phi \left(\frac{\ln \left(a/A_m \right)}{B_R} \right) ,$$

where ϕ (·) is the standard Gaussian cumulative distribution function. The relationship between f_o and a is the median fragility curve for the systems with a median ground acceleration capacity A_m and B_R.

When the modeling uncertainty B_U is included, the fragility becomes a random variable (uncertain). At each acceleration value, the fragility f can be represented by a subjective probability density function. The

Table 4.2

Distribution of Data Sites by Peak Ground Acceleration

Group	Peak Ground Acceleration (No. Systems/No. Failures) 0.1 g	0.2 g	0.3 g	0.4 g
NAS Alameda			90/2	
Oakland Army			22/1	
Oakland Naval Supply			(9/9)[1]	
Port of Oakland			(50/3)[2]	
Treasure Island/Hunters Point		34/2		
San Francisco Airport			80/1	
California Hospitals	61/0	26/1		4/0
Lockheed		300/0		20/1
NAS Moffett		280/0		
Hewlett Packard		20/2		23/2
Totals	61/0	660/5	240/5	47/3
Percentage Failures	N/A	0.8	2.1	6.4

Notes:

Damage due to structural failure is not counted in totals.

1. All nine systems were damaged by ground-related failures.
2. Two systems damaged were in structures with severe structural damage.

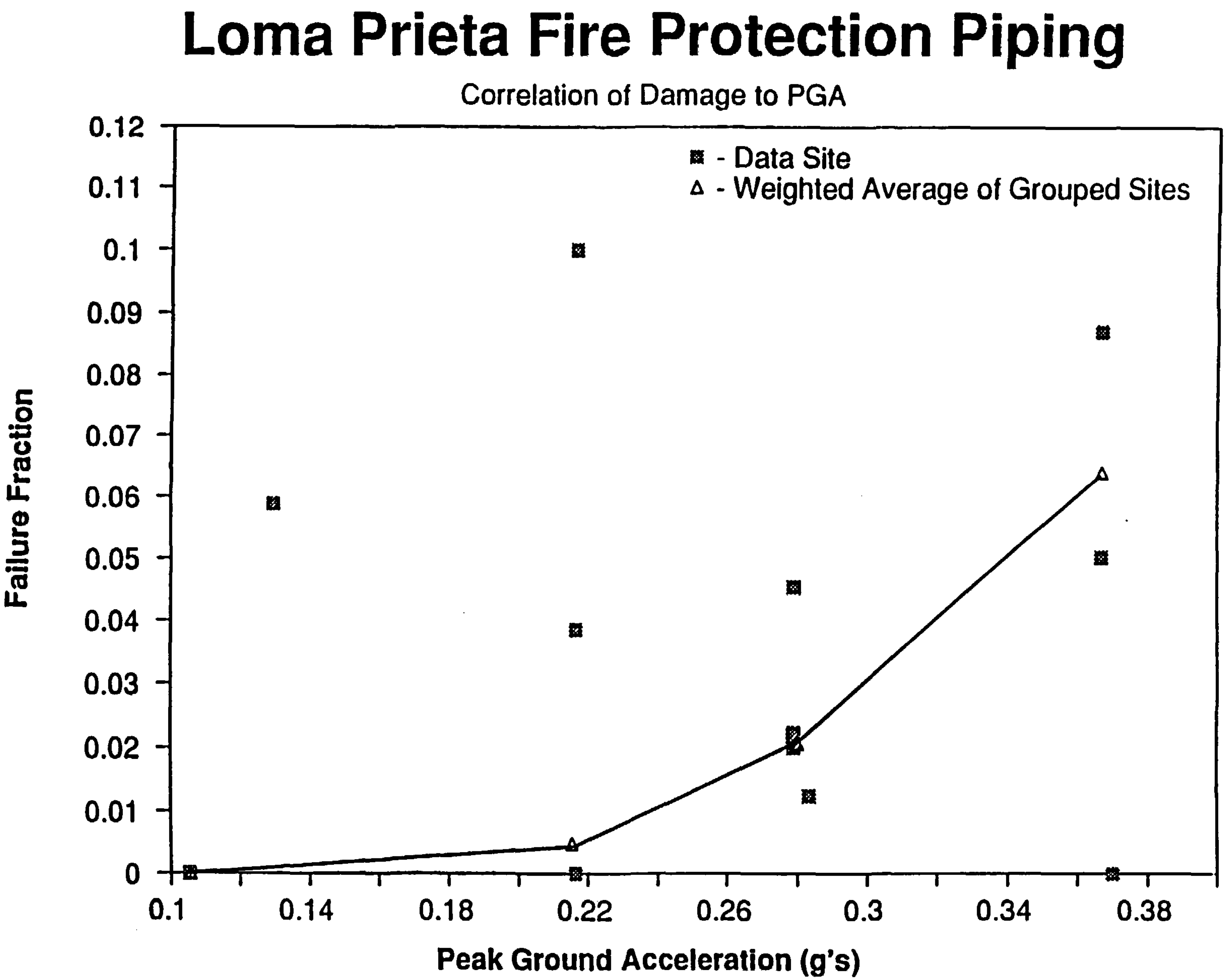


Figure 4.7. Loma Prieta Fire Protection Piping Correlation of Damage to PGA

subjective probability, Q (also known as "confidence") not exceeding a fragility f' is related to f' by

$$f' = \phi \left[\frac{\ln \left(a/A_m\right) + B_U \, \phi^{-1}(Q)}{B_R} \right] ,$$

where

$Q = P[f < f' \quad a]$ i.e., the subjective probability (confidence) that the failure fraction, f_o, is less than f' for a peak ground acceleration a

$\phi^{-1}(\cdot)$ = the inverse of the standard Gaussian cumulative distribution function.

In this application, a composite variability B_C is used which is defined by:

$$B = \sqrt{B_R^2 + B_U^2} \quad .$$

The use of B_C and A_m provides a single "best estimate" fragility curve which does not explicitly separate out uncertainty from underlying randomness.

An extrapolation of the three data points was performed. Data points were taken two at a time and assuming a lognormal distribution (Ref. 4.4) provided median acceleration values, A_m, from about 0.8 g to 0.9 g with an average of 0.85 g and a composite uncertainty of 0.55.

This fragility characterization is applicable to California fire protection piping systems constructed in accordance with modern NFPA-13 seismic requirements.

Corrections for Application to Nuclear Structures

The structures which house these systems are a wide range of commercial and industrial type buildings and therefore have significantly different features which could affect the observed failure modes. These include (a) more flexible buildings with greater seismic response than stiff nuclear power plant structures, (b) differences in pipe routing, congestion and clearance to building features which can result in impact damage and (c) different site conditions and susceptibility to soil-induced failures of underground piping.

Strong-motion accelerographs from the Loma Prieta earthquake were reviewed to assess the amount of amplification in the types of commercial structures associated with this data. U.S. Geological Survey and California Division of Mines and Geology seismographic records (Refs. 4.5

and 4.6) were reviewed for over a dozen structures. These structures included a wide range of buildings of various types of construction. Low-rise one- and two-story structures as well as multi-story and high-rise buildings were included to develop a representative sample of structures in the strong-motion region of the earthquake. The amplification of ground motion within the structures ranged from 1.25 to 4 with an average value of about 2.5.

Several ground-motion response studies for nuclear power plants have been performed. These studies (Refs. 4.7 and 4.8) show that amplifications of 1.5 to about 2.5 are typical for nuclear power plant structures. The median fire protection system fragility when used for evaluation of systems in nuclear structures should therefore be conservatively corrected by a factor to account for these effects. An appropriate factor depends both upon the actual but unknown distribution of structural amplification in the structures from which the data was obtained and on the location and elevation in the particular nuclear structure under evaluation. Based on our review of the data on structural amplification it is recommended that a factor of about 1.33 be used to account for the differences in structural response of the commercial buildings in comparison with nuclear structures. In addition an uncertainty of about 0.3 should be used to account for the distribution in structural response. This would modify the 0.85 g median and 0.55 composite uncertainty in the fragility characterization to about 1.1 g median and a composite uncertainty of about 0.63.

Corrections for the effects of available clearance which may result in impact interaction failures of fragile components are site-specific design details which can only be quantified by individual plant inspection. This failure mode may also affected by both earthquake ground displacement and structural response. Because the failure mode is closely associated with the details of design and installation clearances, no generalized correction for this effect can be applied without plant-specific data.

In the fragility development, an attempt has been made to deaggregate failure modes associated with underground piping and soils-related conditions. Therefore the fragility characterization developed is not appropriate to describe the performance of underground portions of fire protection systems.

Finally, characterization of fire protection sprinkler systems in nuclear power plants which have not been designed to the seismic provisions of NFPA-13 will require adjustments to fragilities. Qualitatively, the fragility of non-seismically designed piping is expected to be somewhat lower than that derived herein. This is due primarily to the failure modes considered which include both inertial shaking failures and impact failures. For systems without the NFPA-13 lateral bracing, relative displacements would be expected to be substantially larger resulting in a somewhat greater number of impact interactions. As discussed above, quantification of these effects is plant-specific and requires data on both design detailing and site spectra.

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5.0 CONCLUSIONS

This study has collected data on fire protection system performance from over two dozen sites during the October 17, 1989 Loma Prieta earthquake. This data represents approximately 100 Halon and CO_2 systems and over 1000 water sprinkler systems.

Twelve strong-ground motion records with peak ground acceleration from 0.1 g to 0.4 g at or near these data sites have been analyzed. The ground motion at sites in the 0.2 g range or greater generally envelope with engineering damage measures associated with an R.G. 1.60 SSE anchored to a 0.2 g PGA with the exception of peak ground displacement.

The study found no instances of damage or failures of Halon or CO_2 systems. This good performance is attributed to significant differences in design codes, installation, and test practices between these and water sprinkler types of systems. A High Confidence Low Probability of Failure (HCLPF) is believed to be greater 0.25 g for these systems.

Thirteen failures of water sprinkler systems were reported. These failures were found to correlate best with peak ground acceleration. The fragilities of these systems corresponding to both inertial shaking and impact interaction was found to be 0.85 g median with a composite uncertainty of 0.55. Only one instance of actuation of a dry preaction system was reported due to mechanical damage. One instance of water intrusion into electrical switchgear was documented.

Underground piping failures were a frequent occurrence in soft soils associated with bay mud and fills. Fire protection system failures due to these soils failures have been deaggregated from the study data and results.

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Nuclear power plants have experienced actuation of fire protection systems (FPSs) under conditions for which these systems were not intended to actuate, and also have experienced advertent actuations with the presence of a fire. These actuations have often damaged safety-related equipment. A review of past occurrences of both types of such events and their impact on plant safety systems, an analysis of the risk impacts of such events on nuclear power plant safety, and a cost-benefit analysis of potential corrective measures has been performed.

Thirteen different scenarios leading to actuation of fire protection systems due to a variety of causes were identified. A quantification of these thirteen root causes, where applicable, was performed on generically applicable scenarios.

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