

Enclosure

SAFETY EVALUATION BY THE DIVISION OF SYSTEMS TECHNOLOGY REGARDING INADVERTENT CONTAINMENT SPRAY EVENTS AT COMMERCIAL NUCLEAR POWER PLANTS

1.0 INTRODUCTION

On November 20, 1990, an inadvertent containment spray actuation occurred at San Onofre Nuclear Generating Station, Unit No. 2 (SONGS-2). The unit was operating at 100 percent power when approximately 5,000 gallons of borated water was sprayed into containment during surveillance testing. Southern California Edison Company (SCE or the licensee) opted not to shutdown SONGS-2 immediately following this event based on previous experience with a similar event that occurred in 1984 at SONGS-2. Following the 1984 event, SCE conducted a detailed inspection and testing program to evaluate the effects of containment spray on equipment and, based on the results of that evaluation, SCE judged that the borated water that was sprayed during the event did not have any immediate adverse effects on safety-related equipment. Therefore, SCE judged that SONGS-2 could continue to operate following the 1990 event while a thorough evaluation was completed. It was not until SCE found a ground indication associated with one of the control element drive mechanism (CEDM) motor generator sets that SCE decided to shutdown SONGS-2 in order to perform additional troubleshooting and repair of the CEDMs, and SONGS-2 was subsequently shutdown on November 23, 1990. The licensee provided a description of its actions following this event in a letter dated November 27, 1990, and Licensee Event Report (LER) No. 90-14 was submitted for SONGS-2 regarding this event on December 20, 1990.

Following the SONGS-2 event, the Division of Systems Technology (DST) was requested to evaluate whether the actions taken by SCE were appropriate and in general to determine the appropriate course of action for licensees to take following a containment spray event. Therefore, the purpose of this safety evaluation (SE) is to address these issues and to provide recommendations as appropriate.

2.0 REVIEW METHODOLOGY

In order to determine whether SCE's actions in response to the containment spray event of November 20, 1990, were acceptable and in developing a position regarding what the appropriate licensee response should be following a containment spray event, the staff reviewed information to determine what effects containment spray could have on plant systems and components. In this regard, DST reviewed information pertaining to previous containment spray events and other industry experiences that may have some relevance. DST also considered Technical Specification requirements and environmental qualification requirements during the review.

3.0 PREVIOUS CONTAINMENT SPRAY EVENTS

Following the containment spray event that occurred at SONGS-2 on November 20, 1990, the Office for Analysis and Evaluation of Operational Data (AEOD) performed

a study of previous containment spray events that have occurred. The results of that study were documented in a memorandum dated December 6, 1990. The AEOD study concluded that "...there was a limited amount of short term damage caused by these events. Some electrical equipment was degraded due to electrical shorts and corrosion. The fact that electrical equipment inside containment must be designed to operate during postulated accident environments (e.g., hot and wet) appears to have limited the damage to safety-related equipment..."

The data compiled by AEOD regarding containment spray events is represented in Table 1. A review of this data indicates that the containment spray events to date have had minimal impact on both safety-related and on nonsafety-related equipment. Of the six events that occurred during power operation, only one event was identified where the licensee decided to shut down the reactor to facilitate subsequent inspection and testing activities (Oyster Creek; December 21, 1987). Also, one event was identified where an inadvertent ECCS actuation initiated emergency boration which caused the reactor to shut down in addition to initiating containment spray (San Onofre 2; March 9, 1984). The amount of water sprayed during inadvertent containment spray events ranged typically from several hundred gallons to several thousand gallons.

For the most part, the LERs reporting previous containment spray events did not provide much detail regarding actions taken to identify and resolve equipment deficiencies resulting from these events and specific deficiencies identified during subsequent follow-up inspections were not described (the LERs for the Keyhole event (305/85-01) and the Calvert Cliffs event (317/87-08) were a little better than the other LERs in this respect). Although the LERs were lacking in details of this nature, licensees typically concluded that safety-related equipment was not damaged as a result of the containment spray events.

4.0 RELEVANT INDUSTRY EXPERIENCE

DST performed an abbreviated review of relevant industry experience and NRC generic communications in order to identify potential effects that containment spray events could have on plant equipment. The review focused principally on moisture intrusion and corrosion problems.

Information Notice 84-57, "Operating Experience Related to Moisture Intrusion in Safety-Related Electrical Equipment at Commercial Power Plants," dated July 27, 1984, and Information Notice 89-63, "Possible Submergence of Electrical Circuits Located Above the Flood Level Because of Water Intrusion and Lack of Drainage," dated September 5, 1989, discuss potential electrical equipment problems that can occur as a result of moisture intrusion. In most instances, moisture intrusion will cause electrical components to short-circuit, corrode, and ultimately fail. Additional industry experience indicates that, given the proper circumstances, snubbers can become inoperable as a result of prolonged submergence and boric acid solutions can cause significant corrosion and degradation of carbon steel materials. However, DST believes that for the most part, these effects are either immediately obvious or occur over a prolonged period of time such that licensees may evaluate the effects of moisture intrusion on plant equipment without necessarily shutting down the reactor.

TABLE 1
COMPILATION OF CONTAINMENT SPRAY EVENTS

<u>Facility</u>	<u>Event Date</u>	<u>Code</u>	<u>Amount Sprayed</u>	<u>Comments</u>
Sequoyah 1 (PWR)	11/3/78	5	2000 gal	No damaged equipment (LER 335/78-041)
	4/8/80	3	300 gal	Effect on equipment not specifically addressed (LER 368/80-24)
Sequoyah 1 (PWR)	2/11/81	5	100,000 gal	Effect on equipment not specifically addressed (LER 327/81-21)
San Onofre 1 (PWR)	9/25/81	5	400 gal	No damaged equipment (LER 206/81-23)
Oyster Creek (BWR)	12/21/82	1	2200 gal	Plant was shutdown for testing and inspection (no LER)
Key Bore (BWR)	2/23/83	1	--	ICS operated for 15 sec. containment inspected, no damage (LER 305/83-06)
ANO 2 (PWR)	3/8/83	1	2450 gal	Visual inspection, no damage (LER 368/83-15)
San Onofre 2 (PWR)	3/9/84	1	6000 gal	ECCS actuation also caused emergency boration and plant shutdown, inspection and testing performed, no damage (LER 361/84-16)
Palisades (PWR)	7/19/84	4	3000 gal	Effect on equipment not specifically addressed (LER 255/84-11)
Pilgrim 1 (BWR)	9/29/84	6	10,000 gal	Damage to lagging (LER 293/84-15)

TABLE 1 CONTINUED

<u>Facility</u>	<u>Event Date</u>	<u>Mode</u>	<u>Amount Sprayed</u>	<u>Comments</u>
Kewaunee (PWR)	1/22/85	1	2500 gal	Plant shutdown on 2/8/85 for refueling, misc. spurious indications related to nonsafety-related equipment, battery ground alarms on A and B batteries, subsequent spurious start of RCP on 2/10/85 (LER 305/85-01)
Waterford 3 (PWR)	2/20/85	3	500 gal	Minor ground on bular crane, isolation of CCW caused degradation of RCP seals (LER 382/85-06)
Calvert Cliffs 1 (PWR)	4/14/87	5	4000 gal	Inspection and testing conducted, no damaged equipment (LER 317/87-08)
San Onofre 2 (PWR)	11/20/90	1	5000 gal	Inspection and testing, subsequent shutdown due to degraded CEDM electrical connectors (SCE letter 11/27/90; LER 361/90-14)

5.0 TECHNICAL SPECIFICATION AND ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Technical Specification requirements specify limiting conditions for operation (LCOs) that must be satisfied during various modes of reactor operation. The Technical Specifications do not specifically require that reactors be shut down following containment spray events, but licensees must satisfy LCO requirements for equipment that becomes degraded as a result of these events. Additionally, depending on the specific circumstances involved, certain LCOs may be directly impacted following containment spray events and these LCOs deserve special consideration. For example, reactor coolant system leakage detection systems may become degraded, the ability to satisfy operational leakage surveillance requirements may be impacted, the inventory of trisodium phosphate (for iodine removal) may be affected, ice condenser performance capability may be degraded, refueling water storage tank level may be reduced, etc. Therefore, specific actions required by Technical Specifications following containment spray events will depend on the actual circumstances involved and licensees should proceed accordingly.

Safety-related equipment located inside containment must be environmentally qualified in accordance with 10 CFR 50.49 requirements and, to a large degree, this helps to minimize the adverse effects that containment spray will have on this equipment. However, environmental qualification (EQ) requirements vary depending on how long the component must function following an accident. Some components may only be qualified to function for a few minutes into an accident while others may be qualified to function for the duration of the accident. Depending on the circumstances, containment spray events could jeopardize the qualification status of components that are not required to operate post-accident. Therefore, the EQ status and operability of equipment located inside containment must be evaluated in detail following containment spray events and corrective actions must be taken as appropriate.

5.0 STAFF POSITION

The information reviewed by DST as discussed in this safety evaluation indicates that inadvertent containment spray events do not necessarily pose an immediate nuclear safety hazard and reactor shutdown following such events may not be necessary. In fact, an immediate reactor shutdown following a containment spray event could make it difficult to fully assess the effects of the event on plant equipment and could further confuse the situation if any complications occur while shutting down the plant. Additionally, Technical Specification requirements and EQ requirements do not impose restrictions on continued reactor operation following containment spray events. Therefore, unless the specific circumstances of the event suggest otherwise, continued reactor operation following containment spray events is acceptable. However, continued operation must be supported by an immediate assessment of plant conditions and an action plan must be developed to fully evaluate the consequences of the event on plant systems and components. Any deficiencies identified should be evaluated in terms of generic implications and corrective actions should be taken as appropriate, which could include subsequent reactor shutdown.

As a minimum, the licensee's immediate assessment of plant conditions should include the following considerations:

- (a) Duration of the event and the amount of water sprayed.
- (b) Spurious equipment actuations, ground indications, and alarms.
- (c) Compliance with Technical Specification requirements.

The licensee's action plan to fully evaluate the consequences of the event on systems and components should include as a minimum the following elements and considerations:

- (a) Personnel hazards.
- (b) Duration of the event and the amount of water sprayed.
- (c) Containment type and configuration of systems and components located inside containment.
- (d) Appearance of accessible areas of containment.
- (e) Control room indication and annunciation.
- (f) Operability of safety-related equipment and compliance with Technical Specification requirements.
- (g) Operability of nonsafety-related equipment and electrical interaction considerations.
- (h) Containment spray system status and boron precipitation considerations.
- (i) Status of snubbers and long term effects.
- (j) Status of equipment qualification and long term effects.
- (k) Status of materials and long term effects (i.e., accelerated corrosion of carbon steel, thermal shock, etc.).
- (l) Development of short term and long term inspection, testing, and surveillance programs.
- (m) Previous industry experience.

The actions taken by SCE in response to the SONGS-2 containment spray event of November 20, 1990, as described in their letter dated November 27, 1990, satisfies the staff's position on this issue and are therefore acceptable in most respects. However, in reviewing the November 27 letter, it is not apparent that SCE completed a detailed review of Technical Specification requirements following the event and SCE's planned review of industry experience should not be narrowly focused on previous containment spray events but should also include a review of industry experience and

NRC generic communications that may be relevant (i.e., moisture intrusion problems, boric acid corrosion problems, etc.). SCE should take action as appropriate to correct these weaknesses.

As a comparison, DST would question the decision that was made by Wisconsin Public Service Corporation to continue reactor plant operation following the Kewaunee containment spray event of January 22, 1985 (see Table 1). The battery ground alarms could have been indicative of seriously degraded safety-related equipment, and the generic implications relative to EQ would have to be addressed. In this case, continued operation may not have been appropriate. Therefore, it is important to recognize that the Regions must play an important role in following events of this nature and in assuring that the actions taken by licensees are appropriate.

The staff's position is based in part on an abbreviated review of industry experience as discussed in Section 4.0 of this safety evaluation. SCE plans to complete a detailed review of industry experience as part of their continuing evaluation of the SONGS-2 containment spray event, and DST will review the details and results of SCE's study to assure that the staff's position on this matter remains valid.

7.0 CONCLUSION

Based on the foregoing evaluation, DST has concluded that continued reactor operation following inadvertent containment spray events is acceptable provided that the specific circumstances of the event do not warrant immediate reactor shutdown. In addition, the actions taken by SCE in response to the SONGS-2 containment spray event of November 20, 1990, are acceptable in most respects. However, some improvements should be made in SCE's evaluation as discussed in Section 6.0 of this SE.

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Date: January 29, 1991