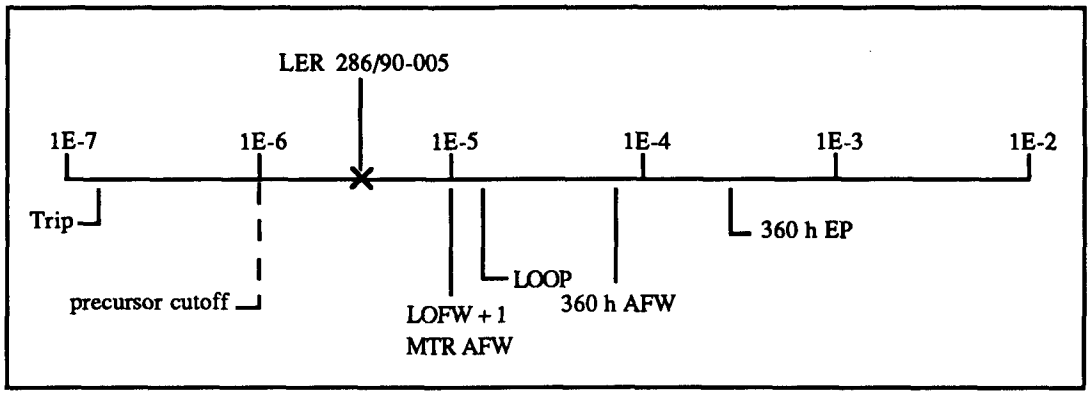
ACCIDENT SEQUENCE PRECURSOR PROGRAM EVENT ANALYSIS

LER No.: 286/90-005
Event Description: All diesel generators potentially inoperable
Date of Event: August 9, 1990
Plant: Indian Point 3

Summary

All diesel generators (DGs) were potentially inoperable for 10.6 h because of an unexpected interaction between the jacket water cooling system and the field flash relays. Following a modification to install a thermostatically-controlled valve in the jacket cooling water system, jacket water pressure would not decrease sufficiently to reset pressure switches used to activate the field flash relays. This resulted in excess current flow through the control power fuses, which caused them to blow. The conditional core damage probability estimated for this event is 3.5×10^{-6}. This value is a bounding estimate, since the control power fuses for different diesels were found blown and replaced at different times. The relative significance of this event compared to other postulated events at Indian Point 3 is shown below.



Event Description

On August 3, 1990, DG 31 was modified to allow operation at a higher service water temperature limit. Part of the modification consisted of replacing a thermostatically controlled valve in the jacket cooling water system. During preoperational checks prior to post-maintenance testing, the control power fuses were found to be blown. Since there was no evidence of other failures, it was concluded that the fuses failed due to "fatigue," and the fuses were replaced. DG 31 was subjected to a full functional test and

returned to service at 2045 h on August 3, 1990.

On August 7, 1990, the same modification was performed on DG 32. During post-maintenance testing, the control power fuses for this DG were also found to be blown. Again, utility personnel concluded the fuses failed due to "fatigue." The fuses were replaced, and the DG was tested and returned to service at 2100 h on August 7, 1990.

On August 9, 1990, at 0502 h, DGs 31 and 32 were tested while DG 33 was out of service to perform the same modification. At 0515 h, control room annunciator "32 EDG Auto Start Defeated" alarmed. The control power fuses for DG 32 were found to be blown. They were replaced and a work request was initiated to investigate the problem with the DG.

Incoming day shift personnel recognized that a problem existed and ran DG 32 at 0710 h to reverify operability. Restoration of DG 33 was also begun.

During restoration of DG 33, its control power fuses were also found to be blown. At 1100 h on August 9, 1990, a plant shutdown was begun and hot shutdown was entered at 1540 h.

During investigation of the problem on DG 32, it was determined that the generator field flashing relays were energized, with the control circuit drawing approximately 17.5 A. Normal shutdown current is approximately 2 A; the fuses are rated at 15 A.

The utility concluded that the field flashing relays remained actuated after initial maintenance and after testing because the jacket water pressure switches, used to initiate field flashing on the DGs, did not reset — a result of the failure of the jacket water system pressure to substantially decay after the DG was stopped once the new thermostatically-controlled valves were installed in the DG jacket water systems.

A temporary change was made to the DG functional test (3PT-V16) to verify that the jacket water pressure switches reset at the end of a test. All control fuses were replaced, and all DGs were subjected to a full-function surveillance test before returning to power.

Additional Event-Related Information

Indian Point 3 utilizes 3 480-V DGs to provide power in the event that offsite power is unavailable. DG 31 supplies safety-related buses 2A and 3A, DG 32 supplies bus 6A, and DG 33 supplies bus 5A. The safety-related buses can be cross-connected through normally open breakers. In addition to the three normal DGs, a separate DG (provided to satisfy Appendix R requirements), can be manually loaded to provide power to safety-

related components.

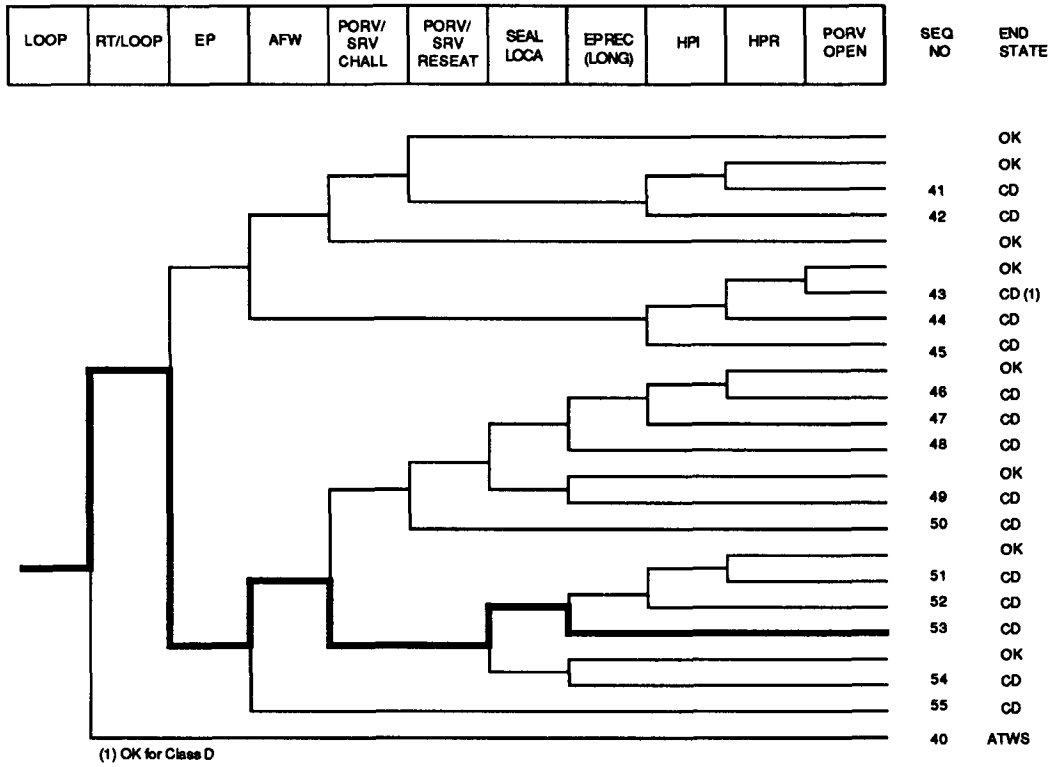
The three Indian Point 3 DGs utilize jacket water pressure to actuate the field flashing relays. The DG control scheme uses jacket water pressure as an indication that the engine is up to speed since the jacket water pump is driven by the DG crankshaft.

ASP Modeling Assumptions and Approach

This event has been conservatively modeled under the assumption that all DGs were unavailable from 0502h on August 9, 1990, until hot shutdown was reached at 1540 h (10.6 h). This time period does not include the time before 0502 h during which DG 33 was out of service (this time is not specified in the LER). During this time, DG 31 and DG 32 may have been capable of starting and supplying power if required. DG 31 successfully operated during testing, and the control power fuses for DG 32 were replaced after they failed at 0515 h. However, the failure mode associated with the event does not appear to be well enough understood to be able to predict which DG would have likely operated on the next demand. A non-recovery likelihood of 0.34 (local recovery at the failed equipment) was assigned to the event.

Analysis Results

The conditional probability of core damage associated with the event is 3.5×10^{-6}. The dominant sequence associated with the event (highlighted on the following event tree), involves a postulated loss of offsite power (LOOP) during the period the DGs were assumed unavailable, failure to recover emergency power, a reactor coolant pump seal loss-of-coolant accident (LOCA), and failure to recover AC power prior to core uncovery.



Dominant core damage sequence for LER 286/90-005

CONDITIONAL CORE DAMAGE PROBABILITY CALCULATIONS

Event Identifier: 286/90-005
Event Description: All diesel generators potentially unavailable
Event Date: 08/09/90
Plant: Indian Point 3

UNAVAILABILITY, DURATION= 10.6

NON-RECOVERABLE INITIATING EVENT PROBABILITIES

LOOP	5.6E-05

SEQUENCE CONDITIONAL PROBABILITY SUMS

End State/Initiator	Probability
CD	
LOOP	3.5E-06
Total	3.5E-06
ATWS	
LOOP	0.0E+00
Total	0.0E+00

SEQUENCE CONDITIONAL PROBABILITIES (PROBABILITY ORDER)

	Sequence	End State	Prob	N Rec**
53	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.loca ep.rec(sl)	CD	2.3E-06	5.7E-02
54	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall - seal.loca ep.rec	CD	7.9E-07	5.7E-02
55	loop -rt/loop EMERG.POWER afw/emerg.power	CD	3.2E-07	2.0E-02
48	loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.loca ep.rec(sl)	CD	9.2E-08	5.7E-02

** non-recovery credit for edited case

SEQUENCE CONDITIONAL PROBABILITIES (SEQUENCE ORDER)

	Sequence	End State	Prob	N Rec**
48	loop -rt/loop EMERG.POWER -afw/emerg.power porv.or.srv.chall - porv.or.srv.reseat/emerg.power seal.loca ep.rec(sl)	CD	9.2E-08	5.7E-02
53	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall seal.loca ep.rec(sl)	CD	2.3E-06	5.7E-02
54	loop -rt/loop EMERG.POWER -afw/emerg.power -porv.or.srv.chall - seal.loca ep.rec	CD	7.9E-07	5.7E-02
55	loop -rt/loop EMERG.POWER afw/emerg.power	CD	3.2E-07	2.0E-02

** non-recovery credit for edited case

Note: For unavailabilities, conditional probability values are differential values which reflect the added risk due to failures associated with an event. Parenthetical values indicate a reduction in risk compared to a similar period without the existing failures.

SEQUENCE MODEL: c:\asp\1989\pwrbseal.cmp
BRANCH MODEL: c:\asp\1989\indpoint.sl1
PROBABILITY FILE: c:\asp\1989\pwr_bsl1.pro

No Recovery Limit

BRANCH FREQUENCIES/PROBABILITIES

Branch	System	Non-Recov	Opr Fail
trans	4.6E-04	1.0E+00	
loop	3.1E-05	1.7E-01	
loca	2.4E-06	4.3E-01	
rt	2.8E-04	1.2E-01	
rt/loop	0.0E+00	1.0E+00	
EMERG.POWER	5.4E-04 > 1.0E+00	8.0E-01 > 3.4E-01	
Branch Model: 1.OF.3			
Train 1 Cond Prob:	5.0E-02 > Failed		
Train 2 Cond Prob:	5.7E-02 > Failed		
Train 3 Cond Prob:	1.9E-01 > Unavailable		
afw	3.8E-04	2.6E-01	
afw/emerg.power	5.0E-02	3.4E-01	
mfw	2.0E-01	3.4E-01	
porv.or.srv.chall	4.0E-02	1.0E+00	
porv.or.srv.reseat	2.0E-02	1.1E-02	
porv.or.srv.reseat/emerg.power	2.0E-02	1.0E+00	
seal.loca	2.1E-01	1.0E+00	
ep.rec(sl)	6.0E-01	1.0E+00	
ep.rec	5.6E-02	1.0E+00	
hpi	3.0E-04	8.4E-01	
hpi(f/b)	3.0E-04	8.4E-01	1.0E-02
hpr/-hpi	1.5E-04	1.0E+00	1.0E-03
porv.open	1.0E-02	1.0E+00	4.0E-04

* branch model file
** forced

Minarick
08-06-1991
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Event Identifier: 286/90-005