LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Fermi 2	0 5 0 0 0 3 4 1	1 OF 8

TITLE (4) Multiple Safety Relief Valves As-Found Settings Outside of One-Percent Tolerance Allowance

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MON	DAY	YR	YR	SEQUENTIAL NUMBER	REVISION NUMBER	MON	DAY	YR	FACILITY NAMES	DOCKET NUMBER (S)
10	25	96	96	- 0 1 7 -	0 2	08	01	97		0 5 0 0 0
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OPERATING MODE (9): 5

POWER LEVEL (10): 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)

X 10 CFR 50.73(a)(2)(v)(D)

OTHER -

(Specify in Abstract below and in text, NRC Form 366A)

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER	
	AREA CODE	
Norm Peterson - Compliance Supervisor	313	586-4258

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	R V	S R V	T 0 2 0	Y					

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

ABSTRACT (16)

On October 25, 1996, during the fifth refueling outage (RF05), Detroit Edison determined that only one of the fifteen safety relief valve (SRV) pilot assemblies tested had lifted within the technical specification (TS) one percent allowable tolerance. Six of the fifteen SRV pilots tested failed to lift within the pressure limit of the test system.

The cause of the SRV setpoint drift has been confirmed to be corrosion-induced bonding of the pilot valve disc and seat. Detroit Edison believes the disc bonding was exacerbated by the following identified Fermi 2 Cycle 5 conditions: (1) Frequent operation at lower power levels may have resulted in lower quality steam (higher moisture content) than in previous cycles; (2) There were more cooldown and heatup cycles experienced in Cycle 5 than in Cycle 3 and Cycle 4; and (3) Cycle 5 was 597 at power days, resulting in a longer time for the oxide bond to strengthen. Furthermore, Detroit Edison believes the Cycle 5 results may have been affected by the Cycle 5 initial setpoint lift testing method which used nitrogen at ambient room temperature.

Corrective actions include: all fifteen Cycle 5 pilots were replaced during the extended fifth refueling outage with refurbished and recertified pilots with platinum alloyed valve discs; these fifteen refurbished SRV pilot valve assemblies with platinum alloyed discs will be replaced with pilots containing either Stellite or platinum alloyed discs during a planned Cycle 6 mid-cycle outage; a License Amendment request to modify the SRV setpoint tolerance criteria from ± 1% to ± 3% will be submitted to the NRC; and an evaluation of plant modifications will be made to improve SRV setpoint reliability.

Initial Plant Condition:

Operational Condition: 5 (Refueling)
Reactor Power: 0 Percent
Reactor Pressure: 0 psig
Reactor Temperature: 98 degrees Fahrenheit

Description of the Event:

A. Background

The Main Steam System [SB] is equipped with fifteen Target Rock two-stage pilot-operated Safety Relief Valves (SRVs)[AC][RV]. The safety function of the SRVs is to prevent the reactor coolant system from being pressurized to more than 110 percent (1375 psig) of the reactor pressure vessel (RPV)[AC][RPV] design pressure of 1250 psig in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section III, 1968, Nuclear Vessels. The Fermi 2 Technical Specifications (TS) Bases state a Safety Limit of 1325 psig vessel steam dome pressure to ensure the RPV bottom pressure does not exceed the 1375 psig value. The Fermi 2 Updated Final Safety Analysis Report (UFSAR) and corresponding General Electric (GE) reload licensing overpressure analysis demonstrate that a total of eleven operable SRVs are adequate to limit reactor pressure to less than ASME B&PV Code allowable values for the worst case transient.

The Target Rock SRV is a dual function valve which can be actuated by system steam pressure exceeding the pilot disc setpoint spring force (the Code safety mode), or it can be actuated by an electrical signal to its electro-pneumatic actuator (relief mode). The electro-pneumatic actuator removes the setpoint spring force so that full steam line pressure lifts the pilot disc. The relief mode of operation was installed for manual operation and for RPV automatic depressurization system (ADS) operation (the nuclear safety-related function applicable to five of the fifteen SRVs). Two additional SRVs receive signals from an automatic control logic using relief mode actuation for the low-low-set (LLS) function that was added prior to initial licensing of Fermi 2.

TS 3.4.2.1 requires that for the safety valve function, at least eleven of the following SRVs shall be operable with the specified code safety valve function lift settings during Operational Conditions 1, 2 and 3:

5 safety/relief valves at 1135 psig +/- 1 percent
5 safety/relief valves at 1145 psig +/- 1 percent
5 safety/relief valves at 1155 psig +/- 1 percent

TS Surveillance 4.4.2.1 requires that at least half of the SRVs be set pressure tested at least once every eighteen months, such that all fifteen SRVs are set pressure tested at least once every forty months. Detroit Edison, based on past results, tests all fifteen SRVs each refueling outage.

B. Event Description

During the fifth refueling outage, the SRV pilot valves were being tested in accordance with TS 4.4.2.1 using a nitrogen testing system at ambient room temperature. This initial testing identified one pilot valve that passed within the one percent acceptance criteria and two pilot valves that would not lift under the maximum applied testing system pressure. Based on an inspection of the pilot discs of these two pilot valves, oxide bonding was suspected as the cause for the failure of the pilot valve assemblies to actuate. In addition, one SRV pilot valve assembly was damaged during installation into the testing system and could not be immediately tested. The remainder of the pilot valves were shipped off-site for confirmatory, independent, testing.

On October 25, 1996, Detroit Edison determined that eleven of the fifteen pilot valves would not have lifted within the TS one percent allowable tolerance. Subsequent testing determined that of the fifteen pilot valves, six would not open under maximum applied test pressure. On November 9, 1996, after consultation with Target Rock, a special test was performed at Wyle Laboratories on the damaged pilot valve that demonstrated the ability of the pilot to lift. Following is a table summarizing the results of the testing:

Valve Number	Nominal Setpoint (psig)	As Found Setpoint (psig)	Percent Drift
B2104-F013A	1135 +/- 11.3	>1288	*
B2104-F013B	1135 +/- 11.3	1230	+ 8.3
B2104-F013C	1135 +/- 11.3	1172	+ 3.3
B2104-F013G	1135 +/- 11.3	1186	+ 4.5
B2104-F013K	1135 +/- 11.3	>1273	*
B2104-F013D	1145 +/- 11.4	>1300	*
B2104-F013F	1145 +/- 11.4	1218	+ 6.4
B2104-F013L	1145 +/- 11.4	1245	+ 8.7
B2104-F013M	1145 +/- 11.4	1170	+ 2.2
B2104-F013N	1145 +/- 11.4	1221	+ 6.6
B2104-F013E	1155 +/- 11.5	>1282	*
B2104-F013H	1155 +/- 11.5	1145	- 0.8
B2104-F013J	1155 +/- 11.5	>1306	*
B2104-F013P	1155 +/- 11.5	>1376	*
B2104-F013R	1155 +/- 11.5	1179 **	+ 2.1

* Did not open during testing.

** Damaged pilot assembly successfully tested on November 9, 1996.

Cause of the Event:

Industry studies performed to date on the Target Rock two stage SRV have indicated that the cause for the high set-point drift test results are attributable to either binding in the labyrinth seal area caused by tolerance buildup during manufacturing, or disc-to-seat corrosion bonding caused by oxides of the disc and seat material forming single joined matrices and inhibiting disc movement. Based on previous Fermi 2 inspection and the testing performed at Wyle Laboratories (setpoint returning to normal after initial operation of the pilot valve, thereby breaking the bond), labyrinth seal binding has been eliminated as a failure mechanism for the Cycle 5 high setpoint drift test results.

Based on independent analysis, Detroit Edison has concluded that the corrosion bonding is the predominant cause for the high setpoint test results. For the corrosion bonding condition, oxygen, temperature and moisture are required to form the bond. The initial oxide bond is believed to form relatively quickly, and then strengthens over time as a result of stellite cobalt diffusion and plant specific steam moisture and chemical content. Detroit Edison believes that a significant contributor to the magnitude of the oxide bond experienced for Cycle 5 was the 597 at power day operating cycle, resulting in a longer time for the oxide bond to strengthen (Cycle 4 was 401 at power days, Cycle 3 was 456 at power days).

Detroit Edison has investigated the plant operational differences between Cycle 5 and previous cycles and believes the corrosion bonding was exacerbated by the following Cycle 5 identified conditions: (1) Frequent operation at low power levels due to turbine vibration and hydrogen cooler problems, as well as several forced outages, may have resulted in lower quality steam (higher moisture content) in the SRV piping area; and (2) the number of cooldown and heatup cycles for Cycle 5 was greater than for Cycle 3 and Cycle 4.

Chemistry for Cycle 5 was also evaluated. No unusual excursions from previous cycles were identified that could account for the degree of SRV pilot setpoint drift due to the oxide bond formation. Offsite laboratory analysis of the composition of the oxide on the disc-to-seat bonds did not identify any elements present that are not consistent with industry analyzed oxide bonding. Therefore, Detroit Edison does not believe that Fermi 2 Cycle 5 chemistry was a significant contributor to the oxide bond formation.

A review of SRV location and pilot valve serial number was performed. No correlation between pilot valve serial number, tail pipe temperatures recorded (indication of SRV leakage), steam line location, setpoint grouping, nor function (ADS or LLS) was identified.

The records for the previous two pilot valve refurbishment and recertification processes were reviewed. The pilot valves were refurbished in accordance with Target Rock procedures and recertified in accordance with approved test facility procedures under the supervision of Detroit Edison personnel with no significant anomalies identified.

Analysis of the Event:

The SRV capacity of the Fermi 2 plant is sized to limit the primary system pressure, including transients, to the requirements of the ASME B&PV Code, Section III, 1968, Nuclear Vessels. Pressure relieving devices may not alone provide complete protection without crediting other protective functions as permitted by the ASME Code. The original Fermi 2 SRV sizing evaluation, described in the Fermi 2 UFSAR, assumes credit for operation of the scram protective system. Fermi 2 reload analysis of the reactor vessel overpressure protection capacity is currently performed by GE, Nuclear Energy Division, using their licensed GESTAR II methodology.

Under the general requirements for protection against overpressure as given in Section III of the ASME Code, credit can be allowed for a scram from the reactor protection system. The backup reactor high-neutron-flux scram is conservatively applied as a basis for determining the required capacity of the pressure-relieving dual-purpose SRVs. The application of the direct position scrams could be used since they qualify as acceptable pressure protection devices when determining the required SRV capacity under the provisions of the ASME Code. The direct position scram circuitry is required to be operable in accordance with TS 3.1.1. The operability of the MSIV position switches is routinely proven by TS channel functional testing on a quarterly basis during the operating cycle. The full logic functional test of each channel, from each MSIV switch to and including the relay which initiates the protection system trip, is performed during each refueling outage.

The SRV capacity required for overpressure protection is determined based upon the minimum capacity that will provide an adequate margin between the vessel design pressure and the 110 percent vessel ASME code limit in response to the Main Steam Isolation Valve (MSIV) closure-flux scram event. The required SRV capacity is determined by analyzing the pressure rise from an MSIV closure with a flux scram transient. The reactor was assumed to be operating at a maximum TS vessel dome pressure of 1045 psig. The analysis hypothetically assumed the failure of the direct isolation valve position scram. For the analysis, relief setpoints of the eleven credited SRVs are assumed to be in the range of approximately 1169 to 1190 psig (103 percent of the nominal setpoint).

However, according to standard GE practice (for original sizing and reload licensing analysis), the SRV capacity evaluation does not assume credit for the direct scram, only the indirect flux scram is assumed. Further, no credit is taken for the externally powered relief mode of the dual purpose SRVs in their ASME Code qualified mode of safety operation. The basis of this GE practice is that the reactor protection system is assumed to be subject to a component, logic, or system failure such that one of the trip signals fails. Thus, although the potential failure of the MSIV position switches is of low probability, it is conservatively assumed to fail for the licensing analyses performed prior to initial or reload cycles.

The reactor protection system scram may be tripped by any one of three sources; i.e., direct, neutron flux, or pressure signal. The direct scram signal is derived from position switches mounted on the main steam line isolation valves or the turbine stop valves or from pressure switches mounted on the dump valve of the turbine control valve hydraulic actuation system. The MSIV closure position

switches are actuated when a closure of the control valves is initiated and following eight percent of full stroke MSIV closure travel (TS setpoint).

The logic functional tests successfully performed during the fifth operating cycle and during the fifth refueling outage demonstrate that the MSIV position scram has been effective throughout Cycle 5. This meets the condition for applying the reactor protective system scram credit as allowed by the ASME Code to an overpressure analysis of MSIV closure with direct scram for Cycle 5.

The Cycle 5 reload licensing analyses for Fermi 2 were performed assuming inoperability of the four lowest setpoint SRVs, with the remaining eleven SRVs having set pressures three percent above nominal. The most severe overpressure event resulting from these assumptions yields a peak dome pressure of 1307 psig and a peak RPV bottom pressure of 1323 psig, both of which are within acceptance criteria. Using the as-found condition for all fifteen of the SRVs (six failed, one pass, eight at various setpoints greater than one percent), the most severe overpressure event resulting from these assumptions yields a peak dome pressure of 1349 psig and a peak bottom pressure of 1366 psig.

The overpressure analysis conducted as noted above produces results within the Code acceptance criterion. However, Fermi 2 has also evaluated two additional overpressure events based upon the information now available from Cycle 5. Using a turbine trip without bypass with a reactor scram on turbine stop valve position (more severe than the all-MSIV closure event with scram on MSIV position) from 102 percent of rated power, and all other reload licensing assumptions, this event would yield a peak dome pressure of 1262 psig and a peak RPV bottom pressure of 1283 psig, which are within the Fermi 2 TS Safety Limit and the ASME B&PV Code, Section III, acceptance criteria of 1325 psig and 1375 psig, respectively. The all-MSIV closure event using the direct MSIV position as the reactor scram initiation signal yields a peak dome pressure of 1241 psig and a peak bottom pressure of 1263 psig. This analysis satisfies both the ASME Code and the TS Safety Limit. Therefore, the health and safety of the public were not adversely impacted by the condition of the SRV pilots at the end of Fermi 2 Cycle 5.

Detroit Edison believes that operation for Cycle 6 does not have the potential to adversely impact the health and safety of the public. The SRV pilots in service for Cycle 6 will not be subjected to the service conditions believed to exacerbate corrosion bonding. The recent turbine upgrades will result in better plant performance with fewer power reductions. The planned mid-cycle outage for SRV replacement will result in the currently installed SRVs experiencing only about 200 at power days. This is significantly less than the Cycle 5 operating length of 597 days. In addition, the Cycle 6 reload licensing overpressure analysis has more margin than the Cycle 5 overpressure analysis due to Cycle 6 core performance characteristics. Hypothetically, using Cycle 5 SRV pilot valve assembly as-found setpoints applied to Cycle 6 limiting overpressure transient (all-MSIV closure with scram on high neutron flux) would result in a steam dome pressure of 1325 psig and a peak RPV bottom pressure of 1344 psig.

Corrective Actions:

A. Immediate Corrective Actions

Twelve pilot valves were sent to an off-site vendor for confirmatory testing, including the damaged pilot valve assembly. The damaged pilot valve stabilizer disc was broken off, and discussion with Target Rock and Wyle Laboratories indicated that this valve could be initial lift tested, but that follow-up lift testing could not be conducted (the pilot valve would chatter). The eleven undamaged pilot valves all "popped" within three percent of their nominal pressure setpoint after their initial lift (achieved either by the pressure setpoint tests or by subsequent relief mode tests).

Six pilot valves failing to open on demand during testing did not meet the Fermi 2 maintenance rule performance criteria for the reactor pressure vessel (RPV) overpressure protection system. Therefore, the RPV overpressure protection system has been classified as a 10CFR50.65 Maintenance Rule (a)(1) system requiring that a reliability improvement plan be developed.

All fifteen pilot assemblies were replaced with refurbished and recertified assemblies, using platinum alloyed discs, in the SRVs for Cycle 6 plant operation.

B. Corrective Actions to Prevent Recurrence

1. The fifteen refurbished SRV pilot valve assemblies with platinum alloyed discs installed during the extended fifth refueling outage will be replaced, using pilots with either Stellite or platinum alloyed discs during a planned Cycle 6 mid-cycle outage.

2. A License Amendment request to modify the SRV setpoint tolerance criteria from ± 1% to ± 3% will be submitted to the NRC.

3. A modification to actuate the pilot during pressure transients by use of a pressure switch is being evaluated.

4. Detroit Edison will continue to follow industry developments and the Fermi 2 site specific investigation related to the improved reliability of SRV setpoint performance. If better solutions than those proposed above are identified, Detroit Edison will evaluate those approaches for possible implementation.

Additional Information:

A. Failed Components

Component: Main Steam Safety Relief Valve
Description: Two Stage Safety Relief Valve
Manufacturer/Model: Target Rock Company, Model 7567F

B. Previous LERs on Similar Problems

LER 94-002: "Safety Relief Valve Set Pressures Outside of Technical Specification Limits"

LER 92-009: "Safety Relief Valves Set Pressure Outside Technical Specification Limit"

LER 91-013: "Safety Relief Valves Set Pressure Outside Technical Specification Limit"

LER 89-028: "Safety Relief Valves Fail Their Set Pressure Tolerance Test"

LER 88-009 "Safety Relief Valves Fail Their Set Pressure Tolerance Test"

LER 86-013: "Reactor Coolant System Safety Relief Valves Exceed Nameplate Set Pressure Surveillance Test Tolerances"