NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Dresden Nuclear Power Station, Unit 2	05000237	1 of 7

Supplement to Reactor Scram Results From Unit Auxiliary Transformer 21 Modification Design Error Due To Inadequate Supervisory Methods and Inadequate Interface with the Testing Organization

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	N/A
									N/A	
04	20	98	98	008	01	08	31	98	FACILITY NAME N/A	DOCKET NUMBER N/A

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more) (11)							
POWER LEVEL (10)	060		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(2)(i)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.405(a)(1)(ii)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)	X	50.73(a)(2)(iv)		OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
J. Kovach, Design Engineering	(815) 942-2920 ext 3645

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

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

ABSTRACT (Limit to 1400 spaces, i. e., approximately 15 single-spaced typewritten lines) (16)

On April 20, 1998 at 0858 hours, a main generator trip occurred causing a unit scram. The cause of the trip is attributed to a design error in a modification that was installed during D2R15 that added additional protective relaying for the Unit Auxiliary Transformer (UAT) T-21 as a design enhancement. New auxiliary current transformers (CT's) were added to obtain the required circuit configuration. A design error was made in connecting the secondary windings of the CT's that were used to re-establish the input to the existing transformer differential relays. With the unit at power and sufficient bus loading, the design error caused the differential relays to respond to a current mismatch that simulated a differential condition. The protective relays actuated causing initiation of a generator trip which led to a reactor scram. The safety significance of this event was minimal. No safety systems were required nor utilized in controlling the plant during scram recovery or cooldown to cold shutdown conditions. All safety systems were available during the event and the Reactor Protection System performed as designed. Immediate corrective action was taken to issue a modification addendum to correct the wiring error. A special test procedure was prepared to perform in-service testing of the modification, and the existing differential relays. The revised modification was installed and the unit was returned to service on April 22, 1998. With the unit synchronized to the grid, the special test procedure was performed and all relaying affected by the modification was verified to be functioning properly. Long term corrective actions included review of past modifications to ensure adequacy of the modifications and independent review, preparation of an inter-department interface agreement on methods to handle similar modifications in the future, formalize requirement for Nuclear Operational Analysis Depatrtment (NOAD) test input to the design modification process, and a review of preparer/reviewer requirements with design engineers. A search of the INPO and Dresden PIF databases was performed and one similar industry event involving a relay design error was identified.

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2527 MWt rated core thermal power

Energy Industry Identification System (EIIS) Codes are identified in the text as [XX] and are obtained from IEEE Standard 805-1984, IEEE Recommended Practice for System Identification in Nuclear Power Plants and Related Facilities.

EVENT IDENTIFICATION:

Supplement to Reactor Scram Results From Unit Auxiliary Transformer 21 Modification Design Error Due To Inadequate Supervisory Methods and Inadequate Interface with the Testing Organization

A. PLANT CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: 4/20/98 Event Time: 0858 CDT
Reactor Mode: 1 Mode Name: Run Power Level: 060
Reactor Coolant System Pressure: 1000 psig

On 4/20/98, during power ascension, the 2A Containment Cooling Service Water (CCSW) [BI] pump was being started in preparation for placing torus cooling [BO] in operation. The unit electrical lineup was different for this startup in preparation for feedwater system [SJ] testing. A feedwater pump that would normally have been loaded on Unit Auxiliary Transformer T21 [EA] was loaded on the Reserve Auxiliary Transformer (RAT) T22 [EA]. This electrical lineup resulted in normal startup loading not being placed on TR-21 until the CCSW pump was started.

B. DESCRIPTION OF EVENT:

This LER is being submitted pursuant to 10 CFR 50.73(a)(2)(iv), which requires the reporting of any event or condition that results in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS) [JC].

At 0858 on 4/20/98, a main generator trip occurred concurrent with the start of the 2A CCSW pump, which resulted in a reactor scram. The 2A CCSW pump was being started in preparation for placing torus cooling in operation. The scram was caused by a Turbine/Generator [TA/TB] mismatch signal as a result of a generator trip. No safety systems were required nor utilized in controlling the plant during scram recovery or cooldown to cold shutdown conditions. All safety systems were available during the event. The electrical systems transferred as designed to the Reserve Auxiliary Transformer.

The RPS performed as designed. The Turbine/Generator Load Mismatch scram occurs when a Main Generator trip causes a turbine trip while the first stage turbine pressure is greater than that which corresponds to 45 percent rated core thermal power. The generator trip occurred from a Transformer 21 differential current signal as indicated by the relay targets that were found actuated on the A and B phases of the T21 relays.

Although any unplanned scram creates safety challenges, the plant response and Operator actions, conducted in accordance with procedures, mitigated the significance of the incident. When reactor water level decreased to approximately +8 inches, a Group 2 and 3 isolation, and auto start of 2/3 B Standby Gas

Treatment System [BH] occurred.

Feedwater Level control [JB] was maintained in 3-element control throughout the event, all three feedwater valve controllers were maintained in auto at all times, and no operator intervention was required to secure the running reactor feed pumps to control level. Stable plant conditions were achieved within a short period of time following the scram.

CAUSE OF EVENT:

The cause of the trip is attributed to a design error in a modification that was installed during D2R15 that added additional protective relaying for the Unit Auxiliary Transformer T21 as a design enhancement. There are two root causes identified for this event. First, the Dresden E/I&C Design Engineering Supervisor failed to recognize that the design was not performed by ComEd's System Protection Department and, as a result, the modification was prepared and reviewed by individuals who did not possess adequate knowledge to prepare and review the design of such a specialized protective relay modification [NRC Cause Code A]. Second, the organization interface between Design Engineering and NOAD was insufficient to require formal identification of required testing [NRC Cause Code E]. The modification required tapping into the existing transformer differential relay circuit to acquire the necessary input for the new relay. New auxiliary current transformers (CT's) were added to obtain the required circuit configuration. A design error was made in connecting the secondary windings of the CT's that were used to re-establish the input to the existing transformer differential relays. The modification was installed as designed.

Construction testing and in-service testing was conducted, however, the scope of the testing was inadequate to identify the error.

With the unit at power and sufficient bus loading, the design error caused the differential relays to respond to a current mismatch that simulated a fault. The protective relays actuated causing initiation of a generator trip which led to a reactor scram.

Weaknesses in the implementation of the modification process that potentially could have detected the error include the following:

1. There were several design review meetings that were held at various stages as the modification evolved. With representatives from the various departments involved in the modification present, the opportunity existed to discuss technical details that could have included vector analyses, CT and relay connections, etc. Such discussions could have led to knowledge of the correct CT connection that would be needed or ultimately, identification of the error prior to issuance of the modification.

1. The modification design did not receive an independent review. The individual that was assigned by the E/I&C Design Engineering Supervisor to take over the modification from the initial preparer did not perform an in depth review of the design, nor did this individual have the experience to perform such an in-depth design review, however, he signed as preparer. A detailed review was also not performed by the ComEd System Protection Department (SPD), although the Electrical /Instrument & Control (E/I&C) design supervisor believed that the basic design was actually provided by SPD. The person that signed as reviewer, turned out to be the same individual that started the initial design.

1. The original design approval letter did not include modification testing requirements. The letter stated that modification testing will be issued in an addendum because discussions were needed with Operations to determine whether a Special Procedure was required or existing Operating Procedures could be revised.

1. Modification Letter Addendum Number 1 stated that modification testing would not be required because construction testing would verify the design and system interactions.

1. Testing by the ComEd Nuclear Operational Analysis Department (NOAD) would have detected the error if all intended (although not formally documented) testing had been carried out.

The following inappropriate actions were identified in the work activities related to this modification:

1. The person that prepared the design experienced an inadvertent lapse in not recognizing the configuration difference between the RAT and UAT. The configuration details are very complex and the transformer connections, although different on the primary windings (wye vs delta respectively), are identical on the secondary windings (wye). This contributed to an incorrect conclusion by the designer that the auxiliary CT connection for the two transformers could be identical.

2. The person that prepared the design also conducted the review of the design. A contributor to this inappropriate action was a lack of people qualified to conduct the review and the belief that the design responsibility had been transferred to the engineer who replaced the original designer. The original designer had previously turned-over design responsibility to his replacement assigned by the E/I&C Design Engineering supervisor who signed as preparer.

3. The modification testing requirements were inadequate to identify the design error. Through-fault testing was added to the testing scope. Further, in-service readings were only required on the new ground overcurrent relays. NOAD Engineers later intended to also check the differential relays, but this intent was not included in the test plan.

4. While the testing was intended to include the differential relays, the NOAD technician decided the testing was not needed.

The following two root causes were identified as leading to this event:

1. The Dresden E/I&C Design Engineering Supervisor failed to recognize that the design was not performed by System Protection Department and, as a result, the protective relay modification was prepared and reviewed by individuals who did not possess adequate knowledge commensurate with the task being performed. [NRC Cause Code A]

   Station E/I&C Design organizations are not expected to possess the knowledge and skills required for protective relay circuit design. These types of modifications are an infrequent type of modification at the station. The interfaces for such specialized design work with other ComEd engineering organizations are not clearly defined.

The preparer, although having past experience in protective relaying, became involved in a modification that was infrequently performed. There are few qualified individuals in the company that could perform the type work involved in this modification. There are no certification guides for this type of work nor are there any intentions that this type of work should be performed on-site on a regular basis.

The conceptual design for this modification was provided by the company's system protection department and had already been installed at other stations. The design supervisor, who was new with the company at the onset of the modification, believed that the schematic design of the protective relay circuits was performed by SPD.

At the conclusion of the initial design (design sketches completed), the preparer was transferred offsite to another position within the company. Prior to departure, the replacement design engineer was tutored on the modification by the original preparer. The replacement engineer signed-off as the preparer on the modification when issued.

There were several design review meetings that were held as the modification progressed from scope kickoff to construction issuance. The comment cycle included personnel with the appropriate background to review this type of modification. The comment cycle led to the belief that everyone who reviewed the modification package "approved" the modification because they did not provide comments. Conversely, the people who commented would have done a more thorough review if asked to approve.

After the modification had been transferred from the original preparer to the replacement design engineer, the original preparer returned to the site to review the final product and signed-off as the reviewer on the modification when issued.

2. The organization interface between Design Engineering and OAD was insufficient to require formal identification of required testing. [NRC Cause Code E)]

The modification testing requirements were specified in the modification approval letter. The individuals involved (primarily the design engineer and the NOAD engineer) lacked the technical knowledge and experience to specify adequate testing.

Testing interfaces between Design Engineering and NOAD with respect to test requirements were not specified.

This modification was previously installed at other ComEd stations. Discussions transpired with respect to the testing that was performed at another ComEd nuclear station. The previous testing experience at that station led to inappropriate acceptance of the adequacy of testing at Dresden.

The belief existed that the NOAD Electrical Construction Test Procedures (ECTP's) were sufficient for inclusion in the modification approval letter and any additional tests could be added by NOAD as they believed appropriate without revising the modification letter.

The through-fault testing that was added to the testing work package (via the minor work instruction revision process) did not prove that the output of the CT's were properly connected to the existing differential relays.

Due to the lack of formal inclusion of test requirements in the modification letter, the NOAD identified requirement for testing the differential relays was allowed to be rationalized away. Further, NOAD informally identified testing was not scheduled in the start-up plan nor in the NOAD test package. Additionally, the four electrical buses (21, 22, 23, and 24) were not in a suitable arrangement (fed from T21) to support complete differential relay testing.

D. SAFETY ANALYSIS

No safety systems were required nor utilized in controlling the plant during scram recovery or cooldown to cold shutdown conditions. All safety systems were available during the event. The electrical systems transferred as designed to the Reserve Auxiliary Transformer, T22 and the RPS performed as designed. Reactor water level decrease stopped at approximately -15 inches indicated, held for a moment, then began to increase in a controlled manner until normal water level of plus 30 inches was reached.

There were no radiation releases to the site or public. The plant was operated within design limits. The health and safety of the public were not compromised as a result of this event. Therefore, safety significance is minimal.

E. CORRECTIVE ACTIONS:

1. Modification addenda DCP 9600067-02 was issued to correct the auxiliary CT wiring configuration error. (Complete)
2. The revised modification was installed under work request 960051030-06. (Complete)
3. In-service testing was performed on the revised modification under Special Procedure SPI 98-04-024. (Complete)
4. The same relay modification (M12-2-96-004) has been issued for the Reserve Auxiliary Transformer (RAT). The RAT modification has not been installed at this time (scheduled for D2R16). A formal documented review will be performed to verify that the CT connections are correctly wired for the RAT modification. (Complete)
5. The E/I&C Design Engineering Supervisor has been counseled in accordance with ComEd policy to ensure appropriate judgement is exercised in future assignment of resources for preparation and review of complex and/or infrequently performed tasks. (Complete)
6. Create and Implement an interface agreement between Design Engineering, NOAD and SPD to assign design responsibility for modifications and changes to protective relays, generators and 4kV and above transformers to SPD. (Complete)
7. Assign NOAD the responsibility to identify their required testing for modifications with testing assigned to NOAD. The test requirements are to be identified in a written test plan and provided as an input to the test requirements in Design Engineering's modification approval letter. (Complete)
8. Required NOAD testing not included in ECTP's , etc. must be included in work instructions or a "special/test procedure" (SP) will be prepared depending on the complexity of the testing. (Complete)
9. Review high-risk modifications that are currently waiting implementation or declared operable in the last six (6) months to ensure adequate design and independent review. Also, review for adequacy of testing. (NTS 237180980080 3S1)

10. Review requirements of preparer/reviewer with all design engineers at Dresden. (Complete)

11. Issue a Nuclear Operations Notification (NON) to other ComEd nuclear stations for applicability of reviewing high-risk modifications to ensure adequacy of testing and design and independent review. (Complete)

F. PREVIOUS OCCURRENCES:

No previous Dresden events were identified that were attributed to a generator trip/reactor scram due to the root causes identified.

A similar industry event (341-980201-1) was identified that was attributed to a generator trip/reactor scram due to a design error in a protective relay circuit. The event was identified through a search of INPO events database. The error involved installation of an incorrect relay type in the generator output breaker circuit logic by the utility relay group. Corrective action included strengthening management oversight.

G. COMPONENT FAILURE DATA:

None