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July 18, 2005

U. S. Nuclear Regulatory Commission  
ATTENTION: Document Control Desk  
Washington, DC 20555-0001

SUBJECT: Duke Energy Corporation  
Catawba Nuclear Station Unit 1 and 2  
Docket Nos. 50-413 and 50-414  
Licensee Event Report 413/2004-003 Revision 1

Attached please find Licensee Event Report 413/2004-003 Revision 1, entitled "Unanalyzed Condition Due To Inadequate Evaluation of Fire Interactions". The original report noted that additional fire areas may be identified with similar fire interactions based upon the continued cable routing evaluations. This revision updates the list of affected fire areas based upon the cable routing reviews.

This report does not contain any NRC commitments.

Questions regarding this Licensee Event Report should be directed to G. K. Strickland at 803-831-3585.

Sincerely,

*R.M. Glavin / for*

D. M. Jamil ←

Attachment

*JE22*



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xc:

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**LICENSEE EVENT REPORT (LER)**

(See reverse for required number of digits/characters for each block)

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-8 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

<b>1. FACILITY NAME</b> Catawba Nuclear Station, Unit 1	<b>2. DOCKET NUMBER</b> 05000 413	<b>3. PAGE</b> 1 OF 9
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**4. TITLE**  
Unanalyzed Condition Due To Inadequate Evaluation of Fire Interactions

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
06	23	2004	2004	- 003 -	01	07	18	2005	Catawba Unit 2	05000 414
									FACILITY NAME	DOCKET NUMBER

<b>9. OPERATING MODE</b> 1	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)</b>										
<b>10. POWER LEVEL</b> 100%	<input type="checkbox"/>	20.2201(b)	<input type="checkbox"/>	20.2203(a)(3)(ii)	<input checked="" type="checkbox"/>	50.73(a)(2)(ii)(B)	<input type="checkbox"/>	50.73(a)(2)(ix)(A)			
	<input type="checkbox"/>	20.2201(d)	<input type="checkbox"/>	20.2203(a)(4)	<input type="checkbox"/>	50.73(a)(2)(iii)	<input type="checkbox"/>	50.73(a)(2)(x)			
	<input type="checkbox"/>	20.2203(a)(1)	<input type="checkbox"/>	50.36(c)(1)(i)(A)	<input type="checkbox"/>	50.73(a)(2)(iv)(A)	<input type="checkbox"/>	73.71(a)(4)			
	<input type="checkbox"/>	20.2203(a)(2)(i)	<input type="checkbox"/>	50.36(c)(1)(ii)(A)	<input type="checkbox"/>	50.73(a)(2)(v)(A)	<input type="checkbox"/>	73.71(a)(5)			
	<input type="checkbox"/>	20.2203(a)(2)(ii)	<input type="checkbox"/>	50.36(c)(2)	<input type="checkbox"/>	50.73(a)(2)(v)(B)	<input type="checkbox"/>	OTHER Specify in Abstract below or in NRC Form 366A			
	<input type="checkbox"/>	20.2203(a)(2)(iii)	<input type="checkbox"/>	50.46(a)(3)(ii)	<input type="checkbox"/>	50.73(a)(2)(v)(C)	<input checked="" type="checkbox"/>				
	<input type="checkbox"/>	20.2203(a)(2)(iv)	<input type="checkbox"/>	50.73(a)(2)(i)(A)	<input type="checkbox"/>	50.73(a)(2)(v)(D)	<input type="checkbox"/>				
	<input type="checkbox"/>	20.2203(a)(2)(v)	<input type="checkbox"/>	50.73(a)(2)(i)(B)	<input type="checkbox"/>	50.73(a)(2)(vii)	<input type="checkbox"/>				
<input type="checkbox"/>	20.2203(a)(2)(vi)	<input type="checkbox"/>	50.73(a)(2)(i)(C)	<input type="checkbox"/>	50.73(a)(2)(viii)(A)	<input type="checkbox"/>					
<input type="checkbox"/>	20.2203(a)(3)(i)	<input type="checkbox"/>	50.73(a)(2)(ii)(A)	<input type="checkbox"/>	50.73(a)(2)(viii)(B)	<input type="checkbox"/>					

**12. LICENSEE CONTACT FOR THIS LER**

<b>NAME</b> G. K. Strickland, Regulatory Compliance	<b>TELEPHONE NUMBER (Include Area Code)</b> 803-831-3585
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**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

<b>14. SUPPLEMENTAL REPORT EXPECTED</b>				<b>15. EXPECTED SUBMISSION DATE</b>			MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	<input checked="" type="checkbox"/>	NO							

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

On June 23, 2004 Catawba identified an unanalyzed condition related to fire protection cable separation requirements. A fire in the Unit 2 A-train 4160V switchgear room (2ETA) [EIIS:EB] was postulated to cause a hot short to spuriously close centrifugal charging pump suction valve 2NV188A and damage the running pump [EIIS:CB]. Because the running pump and the 4160V switchgear room may be opposite train components, the postulated fire may result in both charging pumps being unavailable for post-fire plant recovery. A fire in 2ETA may also affect the standby makeup pump. This postulated loss of both trains of charging pumps was not analyzed in the Safe Shutdown Analysis. On June 24, 2004 Unit 1 was determined to have a similar vulnerability for a fire in the B-train 4160V switchgear room (1ETB).

Further review of the cable routing for the charging pump suction valves identified a fire in 5 additional Unit 1 fire areas and 6 additional Unit 2 fire areas may result in damage to both charging pumps. The Safe Shutdown Analysis for these fire areas was based on one charging pump being available.

The apparent cause is inadequate original Safe Shutdown Analysis of certain spurious hot short valve operations. Corrective actions included fire watches for the switchgear rooms until operating procedures were implemented to protect the correct train charging pump for post-fire plant recovery.

The conditions addressed by this report are related to postulated accidents and potential failures and had no direct effect on the health and safety of the public.

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NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

BACKGROUND AND EVENT DESCRIPTION

This event is being reported in accordance with the 30-day reporting requirement of the Catawba Facility Operating License Section 2F and 50.73(a)(2)(ii)(B).

NUREG-0800 Standard Review Plan and subsequent Safety Evaluation Reports (NUREG-0954) state that one train of systems necessary to achieve and maintain Hot Standby conditions from the control room is required to be free of fire damage. The separation criteria for components to be free from fire damage are:

1. Separation of cables and equipment and associated circuits of redundant trains by a fire barrier having a 3-hour rating; or,
2. Separation of cables and equipment and associated circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system should be installed in the fire area; or,
3. Enclosure of cable and equipment and associated circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system should be installed in the fire area.

If the separation criteria cannot be met, then an alternative, dedicated shutdown capability should be provided.

During the Catawba initial licensing in the early 1980s, Catawba elected to meet the existing fire protection regulations using the following three fire response strategies:

1. Plant shutdown from the control room using A-train equipment.
2. Plant shutdown from the control room using B-train equipment.
3. Plant shutdown from a dedicated, safe shutdown facility independent from the control room.

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**NARRATIVE** (If more space is required, use additional copies of NRC Form 366A) (17)

On June 23, 2004, electrical components were identified within the same fire area that did not meet the cable separation criteria in that a postulated single fire may damage both charging pumps and damage the standby makeup pump cable. The standby makeup pump is used for alternate shutdown to provide reactor coolant pump seal injection flow. The components identified within the fire area for 2ETA include:

- Unit 2 A-train charging pump breaker and cables
- Unit 2 valve 2NV188A breaker and cables (volume control tank outlet valve)
- Unit 2 standby makeup pump cable
- Reactor coolant pump thermal barrier heat exchanger valve breakers and cables [EIIS:CC]

If the Unit 2 B-train charging pump is initially in service and a fire in 2ETA causes valve 2NV188A to hot short to spuriously close, then the 2B charging pump is assumed to be damaged due to a loss of suction. The fire in 2ETA is also assumed to damage the 2A charging pump cable and standby makeup pump cable. The thermal barrier cooling water system is initially in service and should provide cooling to the reactor coolant pump seals unless another hot short causes a second spurious actuation. The Catawba Licensing Basis is to postulate "one worst case spurious actuation". The scenario that includes spurious actuation of both the volume control tank outlet valve and thermal barrier isolation valve is beyond the design basis but is being evaluated for safety significance.

A similar vulnerability exists for the fire area for the Unit 1 B-train 4160V switchgear room (1ETB). Components within 1ETB include:

- Unit 1 B-train charging pump breaker and cables
- Unit 1 valve 1NV189B breaker and cables (volume control tank outlet valve)
- Unit 1 standby makeup pump cable
- Reactor coolant pump thermal barrier heat exchanger valve breakers and cables

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**NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)**

The plant Safe Shutdown Analysis did not consider the postulated common failure mechanism for both charging pumps due to a spurious closure of a volume control tank outlet valve. The analysis assumed that one train of charging pumps would be available following a fire in a 4160V switchgear room.

The 4160V switchgear rooms are equipped with fire detection capability but are not protected by an automatic fire suppression system. The electrical components within each of the 4160V switchgear rooms, 1ETB or 2ETA, are not separated by a 3-hour fire barrier.

Because the cable separation criteria for a 3-hour fire barrier could not be satisfied, operations personnel initiated hourly fire watches in accordance with the Selected Licensee Commitment for Fire Rated Assemblies. Fire watches were started on June 23, 2004 for all four switchgear rooms (1ETA, 1ETB, 2ETA, and 2ETB).

The phone notification to the NRC Operations Center was completed June 23, 2004 for Unit 2 and June 24, 2004 for Unit 1.

Subsequent review of the cable routing for the volume control tank outlet valves identified a fire in the following fire areas may also result in damage to both charging pumps:

- Fire Area 6, 1B Penetration Room
- Fire Area 13, 1A Penetration Room
- Fire Area 15, 1A Switchgear Room
- Fire Area 32, Unit 1 Auxiliary Shutdown Panel A-train
- Fire Area 34, Unit 1 Auxiliary Shutdown Panel B-train
- Fire Area 5, 2B Penetration Room
- Fire Area 7, 2B Switchgear Room
- Fire Area 12, 2A Penetration Room
- Fire Area 31, Unit 2 Auxiliary Shutdown Panel A-train
- Fire Area 33, Unit 1 Auxiliary Shutdown Panel B-train
- Fire Area 46, Unit 2 Corridor

The Safe Shutdown Analysis for these fire areas was based on one charging pump being available.

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A noteworthy design feature of Catawba is the extensive use of grounded, shielded armor cables. The NUREG-0954 Safety Evaluation Report dated February 1983 description of cables states:

"The power, control, and instrumentation cables used in Catawba are of an interlocked armor design in a galvanized steel jacket. All cables pass the IEEE standard 383-1974 flame test. In addition, the applicant has submitted samples of the cable for testing at Underwriters Laboratories in their "corner test" configuration. When subjected to a 400,000 BTU/hr heat flux, the cable exhibited no tendency to propagate fire. In addition, the applicant has conducted tests that demonstrate that no fire propagation from cable to cable or tray to tray occurs as a result of an electrically initiated fire. The staff finds this acceptable."

The Sandia National Laboratories, Circuit Failure Mode and Likelihood Analysis, draft revision 2 December 20, 1999 page 15 states:

"For an armored (metal jacketed) cable, cable-to-cable shorting without a short to ground would be considered highly unlikely, if not impossible. Armoring might also influence the likelihood and duration of non-grounded conductor-to-conductor shorts within the cable. In effect, the armor represents a readily accessible ground plane. The ready availability of a strong ground plane may increase the likelihood of ground shorts, especially considering that the heating during a fire will occur from the outside in. Hence, conductors (or insulation) nearest the cable surface will likely fail first.

Some experimental evidence regarding armored cables is available, in particular, from testing by EdF (EF.30.15.R/96.442). In this program several samples of various armored cables were tested. Most showed evidence of the initial failures involving one conductor and the armor, and relatively few showed conductor-to-conductor shorts independent of the shield. Hence, the experimental evidence indicates that in comparison to non-armored multi-conductor cables, the likelihood of conductor-to-conductor hot shorts is substantially reduced."

Additional correspondence on armored cables is contained in the February 19, 2003 NRC Risk-Informing Post-Fire Shutdown Circuit Analysis Inspection meeting transcript and September 15, 2003 Duke

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letter to the NRC entitled, "Comments on Proposed Generic Communication Risk-Informed Inspection Guidance for Post-Fire Safe Shutdown Inspection".

At the time of this event, Unit 1 and 2 were operating in Mode 1 at 100 percent power. No structures, systems, or components were removed from service that had any effect on the event or conflicted with Technical Specifications.

**CAUSAL FACTORS**

This condition is historical and dates to the original development of the assumptions used to support the Safe Shutdown Analysis. Consequently, a root cause evaluation was not performed. The apparent cause is attributed to an inadequate original Safe Shutdown Analysis of certain spurious hot short valve operations.

**CORRECTIVE ACTIONS**

**Immediate:**

1. Hourly fire watches established for switchgear rooms 1ETA, 1ETB, 2ETA, and 2ETB.

**Subsequent:**

1. Cable routing locations for Unit 1 and Unit 2 charging pump suction valves within ETA and ETB were identified. Valves included the two volume control tank outlet valves (NV188A and NV189B) and the two refueling water storage tank valves (NV252A and NV253B).
2. Following the review and evaluation of the cable routes for NV188A, NV189B, NV252A, and NV253B, guidance was provided to the operators such that control room actions would be taken to maintain at least one charging pump available for post-fire recovery following a fire in the 13 identified fire areas.
3. Following the implementation of the operator guidance, the hourly fire watches were terminated.

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4. Cable routing evaluations were completed for the charging pumps, standby makeup pump, suction and discharge valves for the standby makeup pump, thermal barrier isolation valves, offsite power cables for the 4160V switchgear, and diesel generator power cables for the 4160V switchgear.

Planned:

1. Update the Safe Shutdown Analysis based on the results of the cable routing evaluation.

The planned corrective actions are being addressed within the Catawba Corrective Action Program. There are no NRC commitments contained in this LER.

**SAFETY ANALYSIS**

There were no fire events that challenged the operability of the charging pumps, standby makeup pump, reactor coolant pump seal cooling by seal injection, or thermal barrier heat exchanger operation. The conditions addressed by this report are related to postulated accidents and potential failures and had no direct effect on the health and safety of the public.

The 4160V switchgear rooms have minimal in-situ combustible materials and are maintained free of significant transient combustible materials by administrative controls. Ignition sources are limited to the electrical cabinets and switchgears. The switchgear rooms are equipped with fire detectors to alarm the operators of fire events. The fire brigade members are trained to immediately respond to any plant fire. Test data from the December 2002 EPRI report, Characterization of Fire-Induced Circuit Faults, supports the conclusion that spurious hot shorts will not occur for approximately 30 minutes following fire initiation.

Within the 4160V switchgear rooms, the Unit 2 volume control tank outlet valve cable and the standby makeup pump cable are separated by a horizontal distance of greater than 20 feet with no intervening combustibles. The Unit 1 volume control tank outlet

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valve cable and the standby makeup pump cable are separated by a horizontal distance of approximately 9 feet with no intervening combustibles.

The risk of core damage was analyzed for a potential spurious closure of each unit's volume control tank outlet valve. The analysis was performed using the NRC Fire Significance Determination Process (SDP), Phase II procedure, including use of the SDP Fire Ignition Frequencies, Zone of Influence Charts, and manual suppression curves. The analysis for each area was performed conservatively, with some cables not traced, but assumed failed by any fire. Additionally, numerous conservatisms were applied throughout.

The Phase II analysis showed an overall Core Damage Frequency of less than 1E-06/year for each unit. A number of fire areas were qualitatively screened as low risk, due to a number of factors such as not affecting the SSF and other important components in the PRA scenarios analyzed. A more detailed Fire SDP Phase III calculation would likely result in core damage estimates much lower than the above Phase II results.

The analysis used extensive cable tracing, circuit analysis and walk downs provided by site engineering as a good-faith approximation of cable locations and cable interactions. As Catawba continues with the transition to the NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants, a more formal verification of cable locations will be documented. Therefore, the results of the PRA analysis cannot be considered finalized until the completion of the formal cable location verification.

**ADDITIONAL INFORMATION**

Within the last three years, no other LERs occurred at Catawba involving fire events or the safe shutdown analysis. Therefore, this event was determined to be non-recurring.

Energy Industry Identification System (EIIS) codes are identified in the text as [EIIS: XX].

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This event did not meet the criteria for a Safety System Functional Failure.

There were no releases of radioactive materials, radiation exposures or personnel injuries associated with this event.