

ISSUE STATEMENT

Emergency diesel generator (EDG) system performance has been declining over the past few years and has been a significant contributor to the decline in the overall World Association of Nuclear Operators (WANO) Safety System Performance Indicator. EDG system reliability and availability are also critical to emergency AC power system performance, which can have a significant impact on core damage frequency. Identifying and addressing the technical factors impacting EDG reliability is important to overall nuclear plant safety and performance.

DRIVERS

A 2010 Institute of Nuclear Power Operations report (INPO Technical Report 10-73) identified an increasing trend of EDG failures, stating that the number of failures in the first half of 2010 is greater than any six-month period since 2005. According to INPO, an increased number of plants are not meeting WANO unavailability goals. In an INPO AP-913 Failure Events Update (2009-2011(Q1)) the second highest number of events was attributed to the emergency power supply system. Moreover, recent events at Browns Ferry, North Anna, and Fukushima Dai-Ichi have increased the awareness of EDG system reliability worldwide. Continued declines in EDG reliability and availability could result in increased regulatory actions.

RESULTS IMPLEMENTATION

Upon completion of this work, nuclear power plant management, fleet EDG system leaders, EDG system engineers, and others responsible for EDG reliability and availability will have access to improved guidance and tools for reducing EDG system failures and for effectively managing EDG system reliability and unavailability. Utility processes and personnel will address the technical and programmatic issues with minimal risk of unexpected and undesired behaviors.

Research activities will provide recommendations for the detection, prevention and mitigation of identified reliability problems. INPO operating experience analyses will serve as the bases for addressing current and emerging issues, and will be captured in EPRI's research development plans.

PROJECT PLAN

Significant improvements in industry EDG performance will be realized from a cohesive, coordinated industry effort that targets known gaps. Industry failure data indicates that EDG failures are attributed to a variety of subsystems and underlying causes. Based on industry data and meetings conducted by INPO and EPRI, these gaps have been identified and include leaks, control systems, preventative maintenance program adequacy and implementation, parts issues, training, work management, and life-cycle management.

EPRI has performed a gap analysis on EDG leaks, with input from the industry's EDG owners groups and in cooperation with the Maintenance Working Group (MWG). With respect to leaks, the goal is to identify technologies, materials and methods to reduce or mitigate the effects of leaks. As a result of these efforts, EPRI published 1025733 and INPO published IER 12-82. Solutions for specific design issues will be developed by the owners groups.

EPRI has published a report on EDG control systems, EPRI 1025242, which identifies recommendations to increase EDG reliability. Plants are to review EPRI research results and implement control system maintenance changes as necessary. The industry owners groups will review the research and recommend appropriate changes to their maintenance programs.

INPO will continue their review visits and capture and share lessons learned. INPO will also provide support for data analysis.

In May 2013, INPO issued Industry Event Report (IER) 13-21, Emergency Diesel Generator (EDG) Review Visit Summary. This IER contains input and recommendations provided by the EDG TAC. The IER's *Corrective Actions for Consideration* include performing an EDG single component vulnerability review to ensure that the plant's PM strategy addresses any gaps in maintenance. Considering the industry's intent to perform these reviews, the EDG TAC will develop EDG vulnerability guidance.

The IER also suggests that plants consider:

- Developing a comprehensive improvement plan that leverages the strength of the entire station
- Implementing life cycle management strategies to address generators, exciters, and voltage regulators.

- Implementing a strategy for critical spare parts.
- Improving work management
- Improving monitoring and clearly communicate adverse trends in EDG health reports.

The EDG owners groups will review their maintenance programs to validate completeness, adequacy, and proper task frequencies. EPRI has performed a review and comparison of the various maintenance programs within the industry. Gaps and differences between these programs have been provided to the owners groups and the EDG TAC. Sites/fleets may then perform site-specific reviews of their maintenance programs to compare and contrast to owners group recommendations.

The owners groups will develop critical spare parts listings and identify parts quality issues. Best practices for parts will be developed.

The Maintenance Working Group is addressing maintenance implementation issues and work management issues. This group is working to develop best practices in these areas. The Owners groups and EPRI will work to develop diesel system engineer best practices.

EPRI will review existing guidance on EDG governor and voltage regulator life-cycle management to determine if new or improved management strategies are needed.

RISKS

If the work is funded, there is a risk that equipment reliability issues will still require plant and utility resources to solve.

ROADMAP FLOWCHART

The flowchart will show the major tasks to achieve the roadmap goal. It is not meant to show every single task that needs to be done. The Flowchart will be condensed from a detailed list of tasks.

RECORD OF REVISION

This record of revision will provide a high level summary of the major changes in the document and identify the Roadmap Owner.

REVISION	DESCRIPTION OF CHANGE
0	Original Issue: December 2011 Roadmap Owner: James Sharkey
1	Revision Issued: August 2012 Roadmap Owner: James Sharkey Change: Updated flowchart material to reflect: <ul style="list-style-type: none"> • EPRI report on EDG Controls completed • Gap analysis on leaks completed • Review of industry's maintenance programs has been completed
2	Revision Issued: December 2012 Roadmap Owner: James Sharkey Changes: Updated Project Plan and flowchart material to reflect changes based on EDG TAC meeting held November 7-8, 2012.
3	Revision Issued: August 2013 Roadmap Owner: James Sharkey Changes: Added text on IER 13-21 and marked task complete. Added EDG TAC efforts on EDG Vulnerability Review. Adjusted schedules for (1) EDG Operations and Maintenance Fundamentals, (2) Generator Inspections Summaries. Changed the focus of the ERWG effort.
4	Revision Issued: January 2014 Roadmap Owner: James Sharkey Changes: Revision 4 changes included: <ul style="list-style-type: none"> • Added milestone: Transition (End) of EDG TAC Activities • Changed ERWG task of 'Develop Reliability Index' to 'Consider Diesel Reliability Index' • Deleted long-range, low priority tasks • Extended period of industry group activities • Added task for utilities: 'EDG Vulnerability Reviews'

