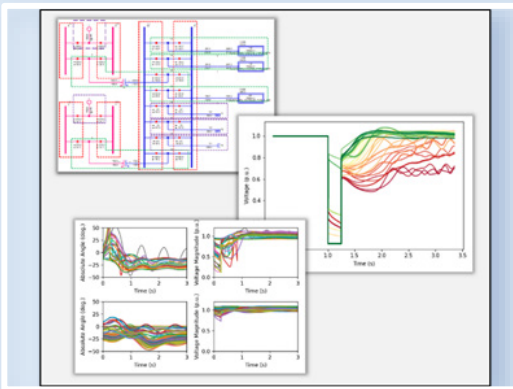


# APPLICATION OF ADVANCED TRANSMISSION RELIABILITY TOOLS



*Advanced Reliability Toolset (ARTS)*

## PROJECT HIGHLIGHTS

- Automate the creation of contingency events for steady-state and dynamic analysis required for annual transmission planning assessments
- Efficiently screen and rank severe contingency impacts for both voltage and transient stability allowing for prioritization and more detailed analysis
- Leverage increased computation and scripting capability to fully automate studies and analysis required for annual transmission planning assessments

## Background, Objectives, and New Learnings

As the nature of power system is changing, it is becoming challenging to assess the reliability of transmission systems given the limitations of the bus-branch positive sequence modeling approach that is the standard today. The latest transmission planning requirements and standards require evaluation of a comprehensive set of contingencies, many requiring a node-breaker topology of the system.

In addition to the complexities associated with topological processing and generation of contingency events, the need to evaluate and classify the stability impacts of new or existing contingency events on the power system are increasingly burdensome. Changes made to the transmission system require new contingency events to be defined while the impacts of existing contingencies must be re-evaluated. Unstable events require further, detailed assessment to identify and determine potential mitigations or solutions to the underlying contingency event.

Increased computational capability has enabled high levels of automation and parallelization in the transmission planning analysis, but contingency definition and post-processing analysis still create significant bottlenecks. Both require significant scrutiny, often taking hundreds of hours, to ensure that they are accurately completed. To advance and improve this process, EPRI has developed a suite of tools called the Advanced Reliability Toolset (ARTS), that integrates applications developed through EPRI's Transmission Planning R&D program, Project Set 40E: Analytics for Emerging Transmission Planning Needs.

The ARTS suite of tools includes the Automated Contingency Generation Tool (ACGT), Protection Control Group (PCG) Engine, Contingency Screening and Ranking Tool (CSRT) – Dynamic Voltage Module (DVM), and CSRT – Transient Stability Module (TSM). These applications are designed to be individually or collectively applied across the transmission planning process. Through this supplemental project, EPRI plans to apply ARTS applications to automate traditionally burdensome stages of the transmission planning process.

## Benefits

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The ACGT and the PCG Engine bring significant automation capability to the contingency creation process, normally an extremely time-consuming process. The CSRT modules improve the efficiency of the post-simulation analysis process by allowing utility planners to screen and prioritize contingency events based on voltage and transient stability impacts from short-term time-domain simulations. Further, this allows planners to determine which contingency events create the most significant stability impacts on their systems using efficient automated script-based processes eliminating traditional inspection processes. Overall, the ARTS suite of tools can be used to assess system reliability providing insights into system reliability issues while potentially saving hundreds of engineering hours annually.

## Project Approach and Summary

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Multiple objectives can be achieved through application of the ARTS suite of tools. The following tasks are envisioned with each project participant through this project.

### Task 1 – Build Node-Breaker Models for Planning Cases:

Work with the funder to build node-breaker models for planning cases using EMS data.

**Task 2 – Automated Contingency Generation Using Node-Breaker Models:** Work with the funder to generate and evaluate NERC TPL-001-5 contingencies generated using the node-breaker modeling from Task 1.

**Task 3 – Automated Processing of contingencies:** Work with funder to automate the dynamic simulation of contingencies created in Task 2 or funder-defined set. If the funder has access to HPC infrastructure, EPRI will facilitate implementation of the selected tools into the automation process utilized with the HPC platform. All tools in the ARTS suite can be automated in the HPC environment through direct Python scripting.

### Task 4 – Contingency Screening and Ranking

**Assessments:** Work with the funder to evaluate the dynamic voltage or transient stability performance of the contingency events. Contingencies created in Task 2, or a funder-defined set can be used for the analysis.

## Deliverables

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The following deliverables are envisioned:

- Periodic webcast and presentations throughout the project.
- Final project presentation summarizing overall results.
- Executive summary report summarizing overall results.
- Supplemental scripts or code developed to facilitate software integration for participants with access to the tools.

## Price of Project

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This project has the following structure for the listed tasks:

- Task 1 and Task 2: \$125,000
- Task 3: \$25,000
- Task 4: \$125,000
- Task 1–4: \$250,000

## Project Status and Schedule

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The timeline for completion of this project is nine to twelve months. This timeline begins once the required data for the selected tasks has been transferred to EPRI.

## Who Should Join

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Utilities who are looking to introduce advanced automation processes to their transmission planning assessments and studies or are looking to fully leverage the capabilities of the node-breaker power flow model.

## Contact Information

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For more information, contact the EPRI Customer Assistance Center at 800.313.3774 ([askepri@epri.com](mailto:askepri@epri.com)).

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